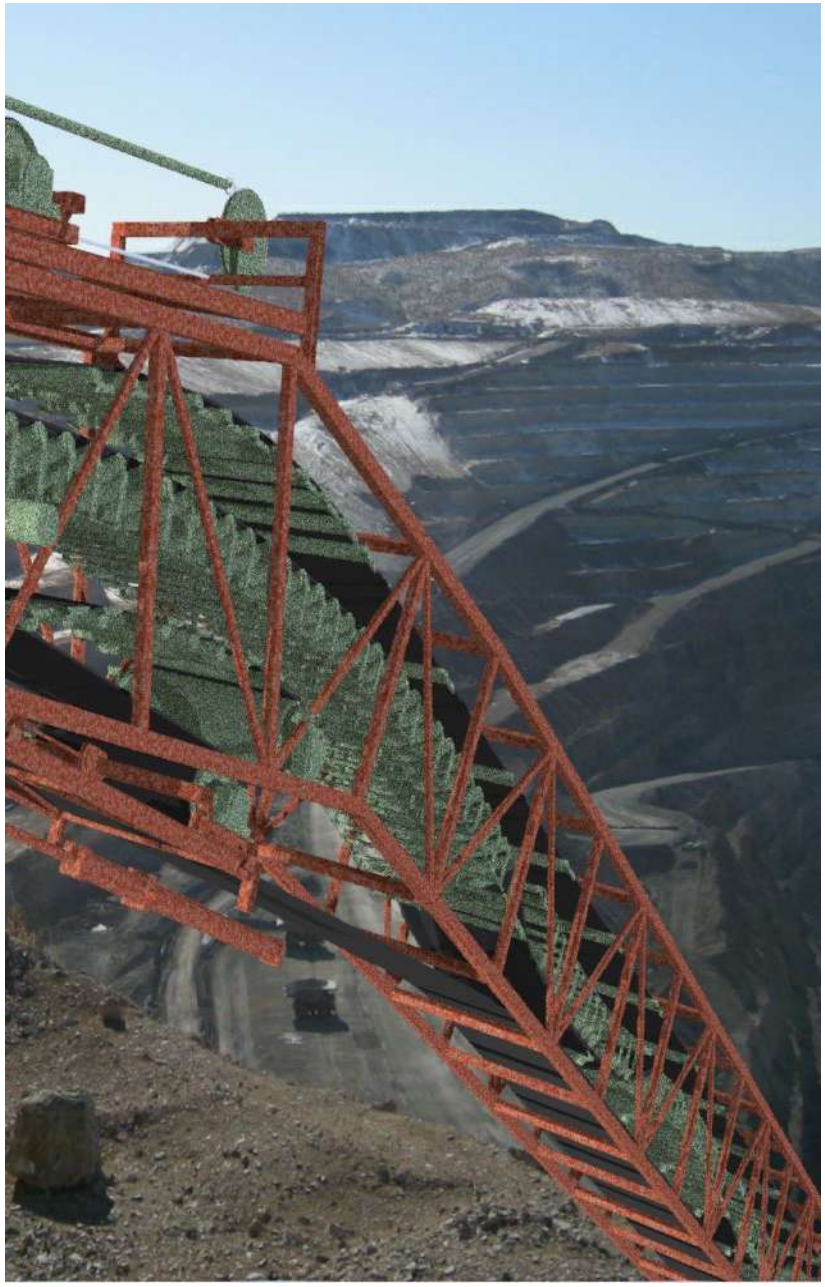


PRESENTATION ON DSI HIGH ANGLE CONVEYOR

BY SHYAMAL KUMAR BAG
E-mail: shyamalkumarbag@gmail.com

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997



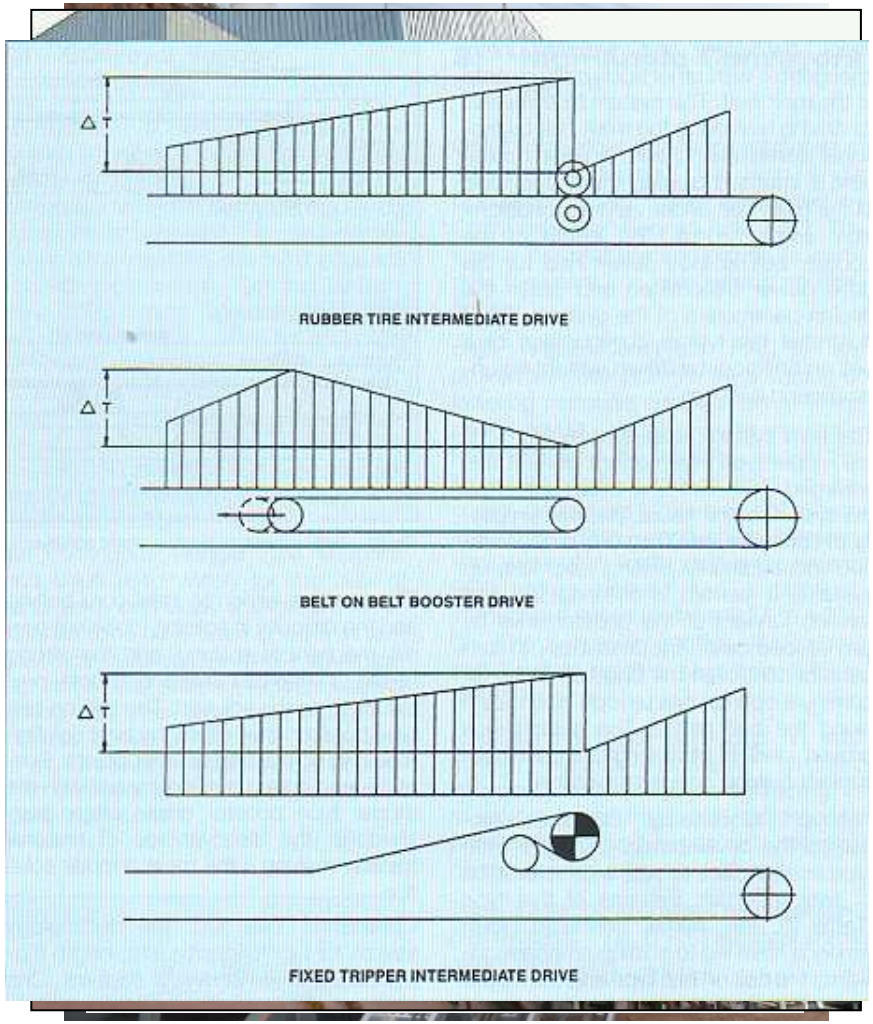

MATERIALS HANDLING & ENGINEERING SPECIALISTS

A legacy of innovation.

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

MATERIALS HANDLING AND ENGINEERING SPECIALISTS



- Long Overland, High Lift, and High Capacity Conveyors - including horizontally curving systems, TBM trailing conveyors
- High Angle Conveyors – world's foremost authority
- High Tech Transfers – association with M&J/WEBA
- Plant Conveyors
- Heavy Belt Feeders
- **Booster Drives** – able to convey great lengths with modest belt strength

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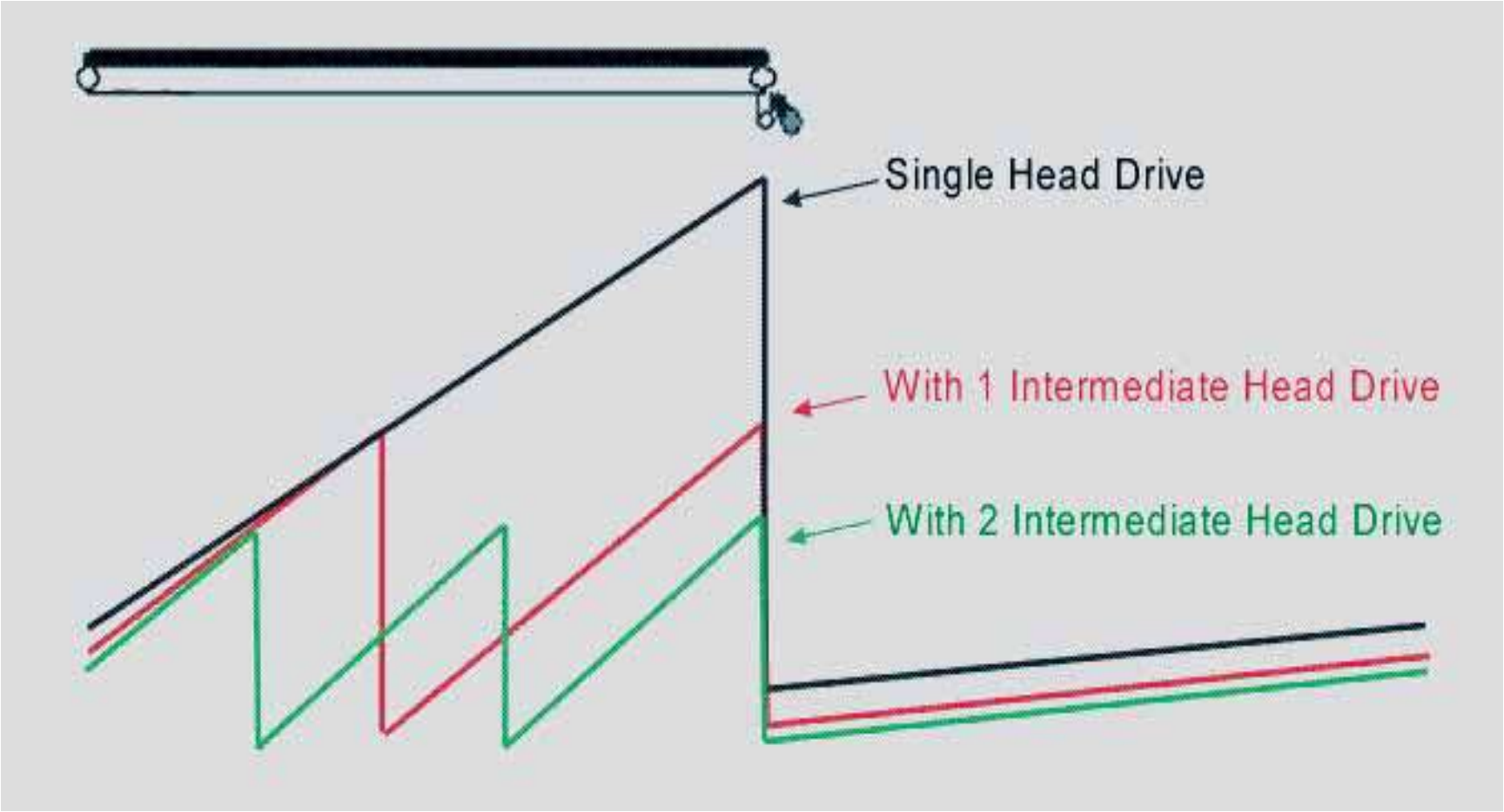
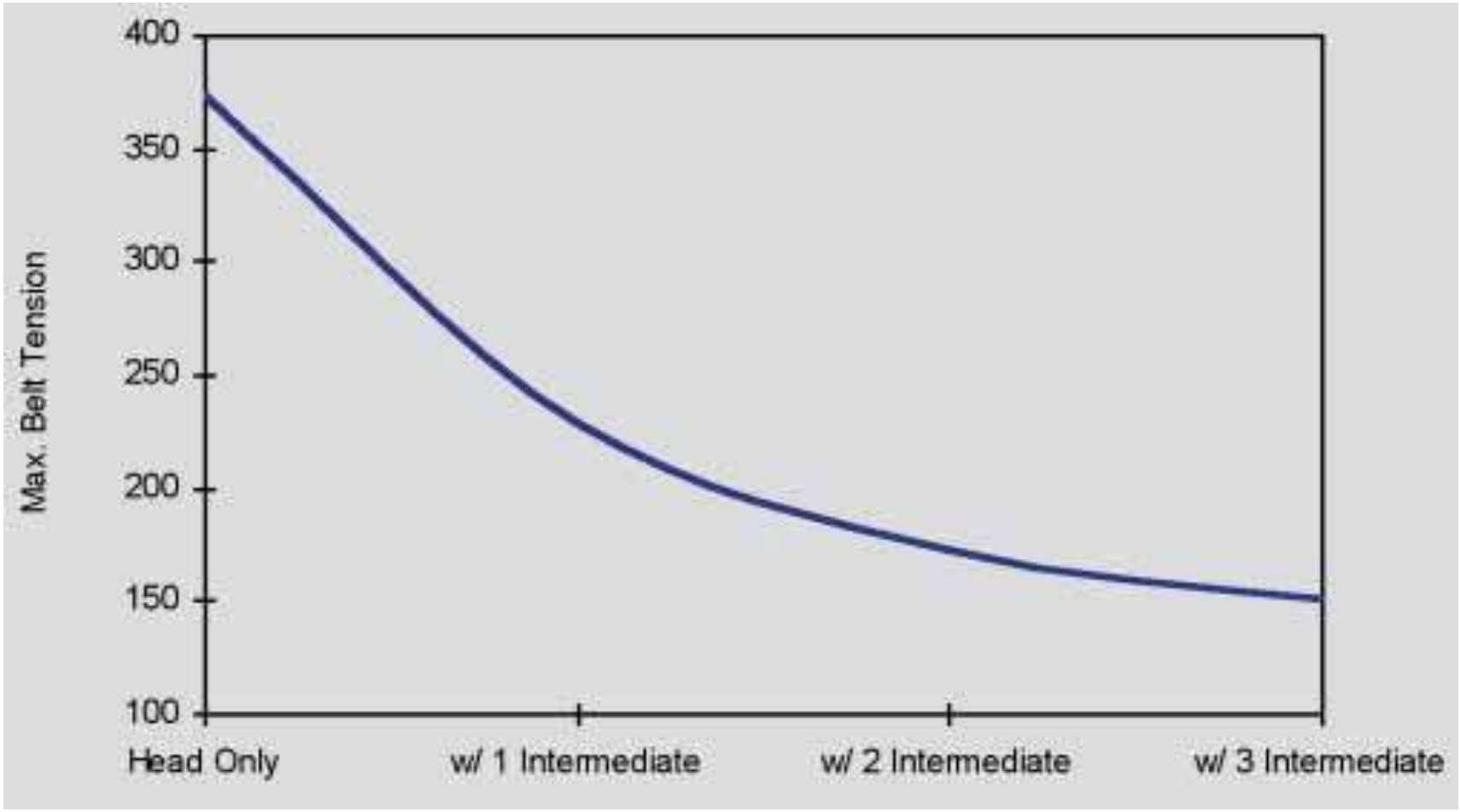
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

CONCEPT OF BOOSTER CONVEYOR



Belt tension diagram for Intermediate drives

BOOSTER CONVEYOR



Maximum belt tension vs. number of drives

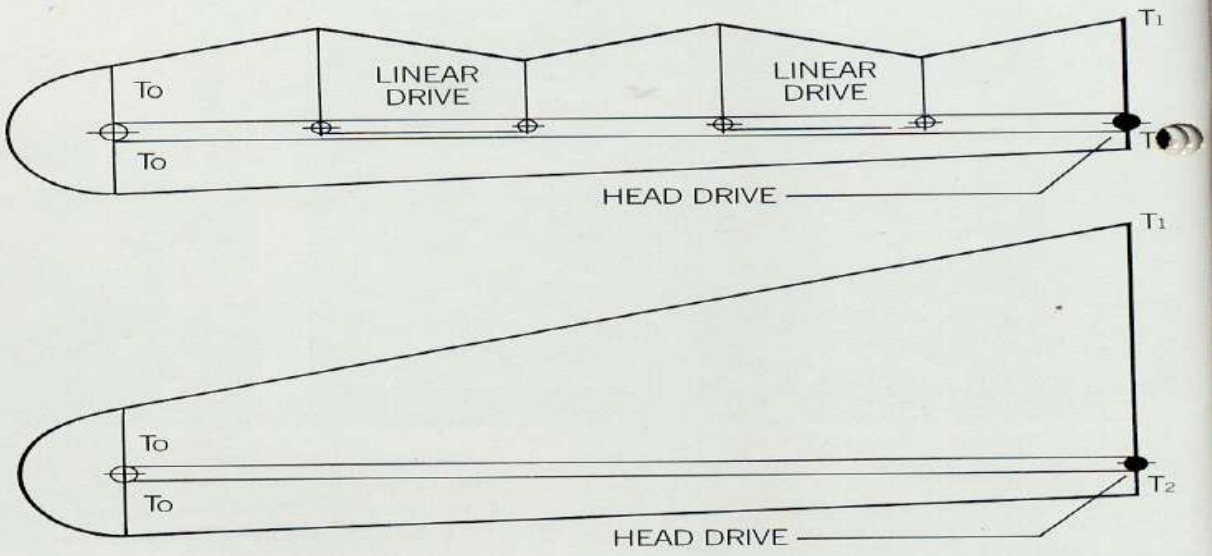
LINEAR / BOOSTER CONVEYOR

THIS BOOSTER CONVEYOR IS A PART OF COMPLETE SYSTEM IN A POTASH MINE. THE LENGTH OF THE CONVEYOR IS 1740 M & LIFT 284 M. INITIAL OUTPUT WAS 500 TPH RISING TO 1000 TPH. THE 1050 KW, 800 MM WIDE CONVEYOR USES AN INTERMEDIATE GRADE FABRIC BELT & 150 kW TRANSMISSION UNITS IDENTICAL TO THOSE ON ALL THE CONVEYORS IN THE SYSTEM.

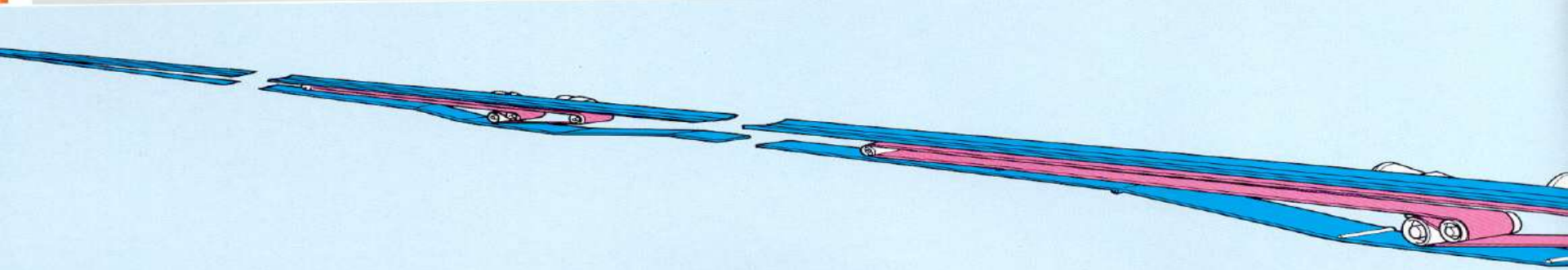
LINEAR CONVEYORS

The linear drive system applies power at one or more points along the conveyor and at the head drive and has several benefits:-

- lower maximum belt tension
- belt of lower tensile strength
- reduced weight of belt
- lower installed power
- increased length of single flight conveyor
- elimination of transfer points
- progressive increase of length, power and load with the same belting
- modular driving units with benefit of standardisation and reduced physical size of components
- improved man-riding facilities
- lower capital cost



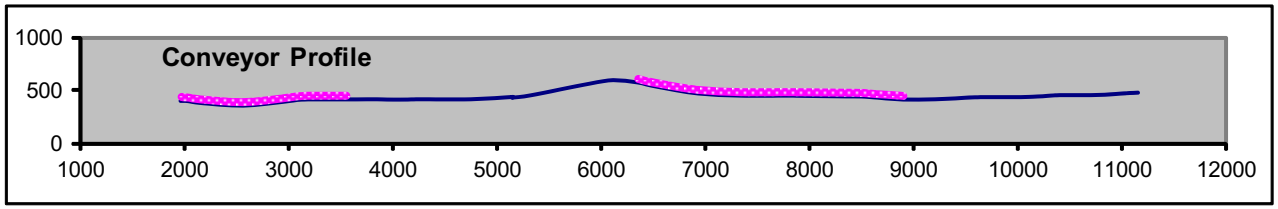
The reduction in maximum belt tension is demonstrated in the tensi diagram for a conventional head drive and for the same duty with a linear system.



DSI ExConTec

Complete Power/Tension Analysis Program

Real Time Analysis



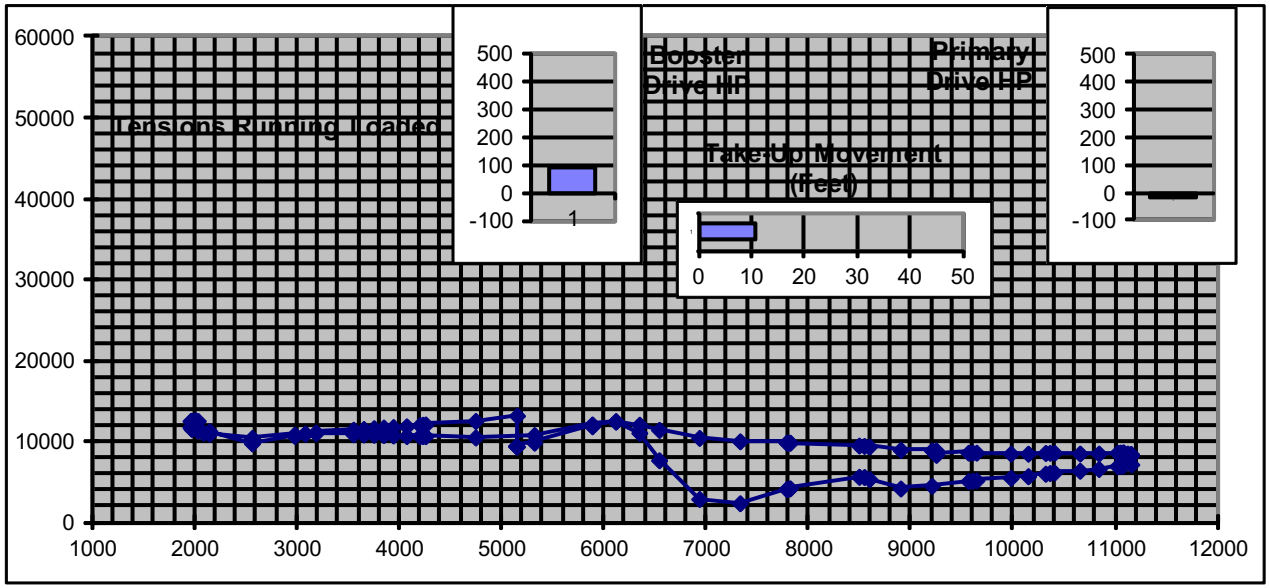
Belt Width:	36 ins	Conveyor Length:	9250 ft	Lift:	77.5 ft
Belt Wt:	13.7 lbs/ft	Idler Spacing:	5 ft - Trouh		10 ft - Return
CONVEYING RATE:	1800 STPH	BELT SPEED:	750 FPM		

LOAD

UNLOAD

-17.599982

87.731559



Discretionary Factors

Discretion by Responsible Engineer:					
	Ky Adjust:	0.83	Input	0.83	Default
	Kx Adjust:	1.5	Input	1.5	Default
RUN	Term. Adj.:		Input	1	Default
	T-U Tension	8400	lbs	AT NODE 1	

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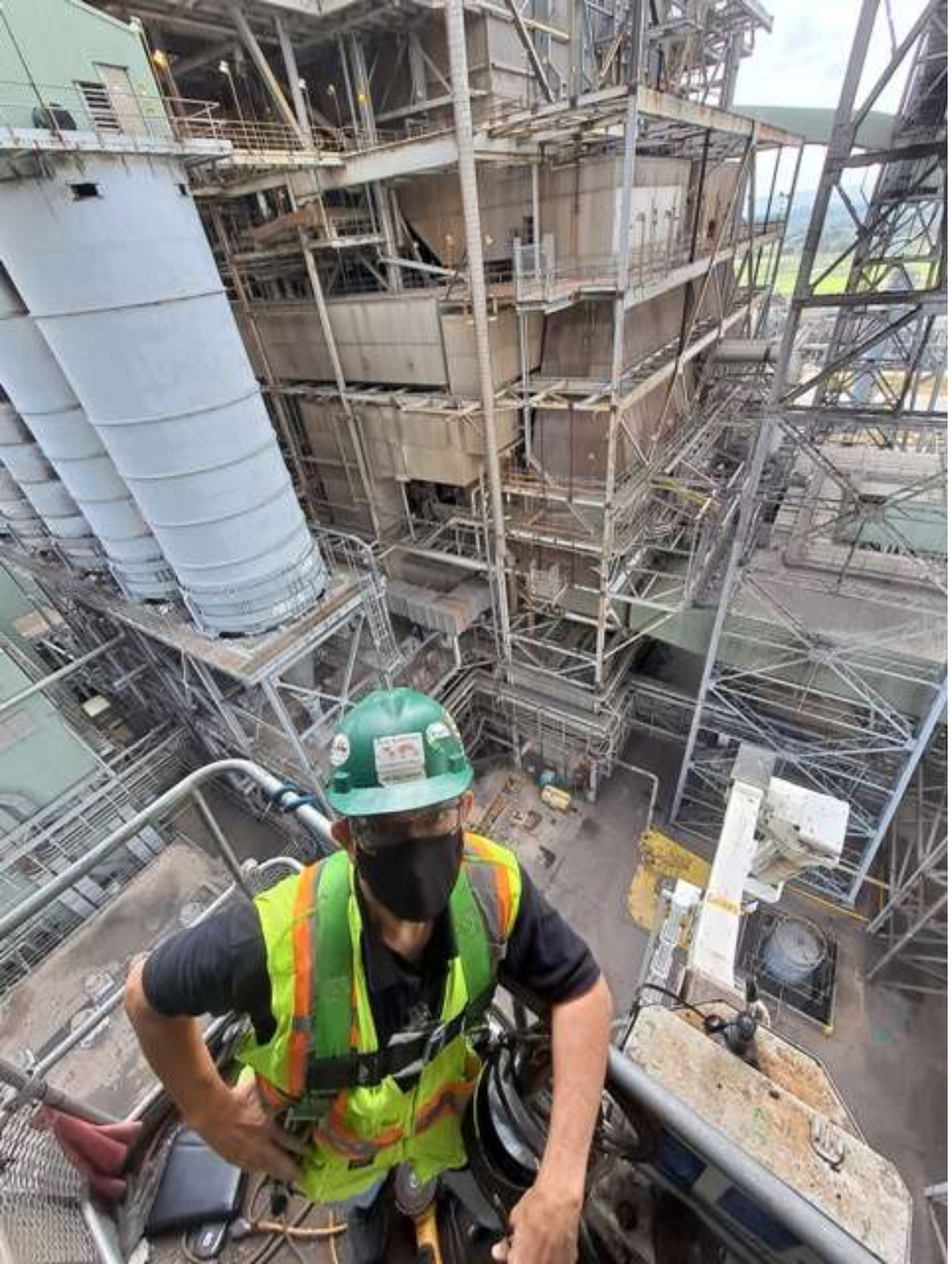
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

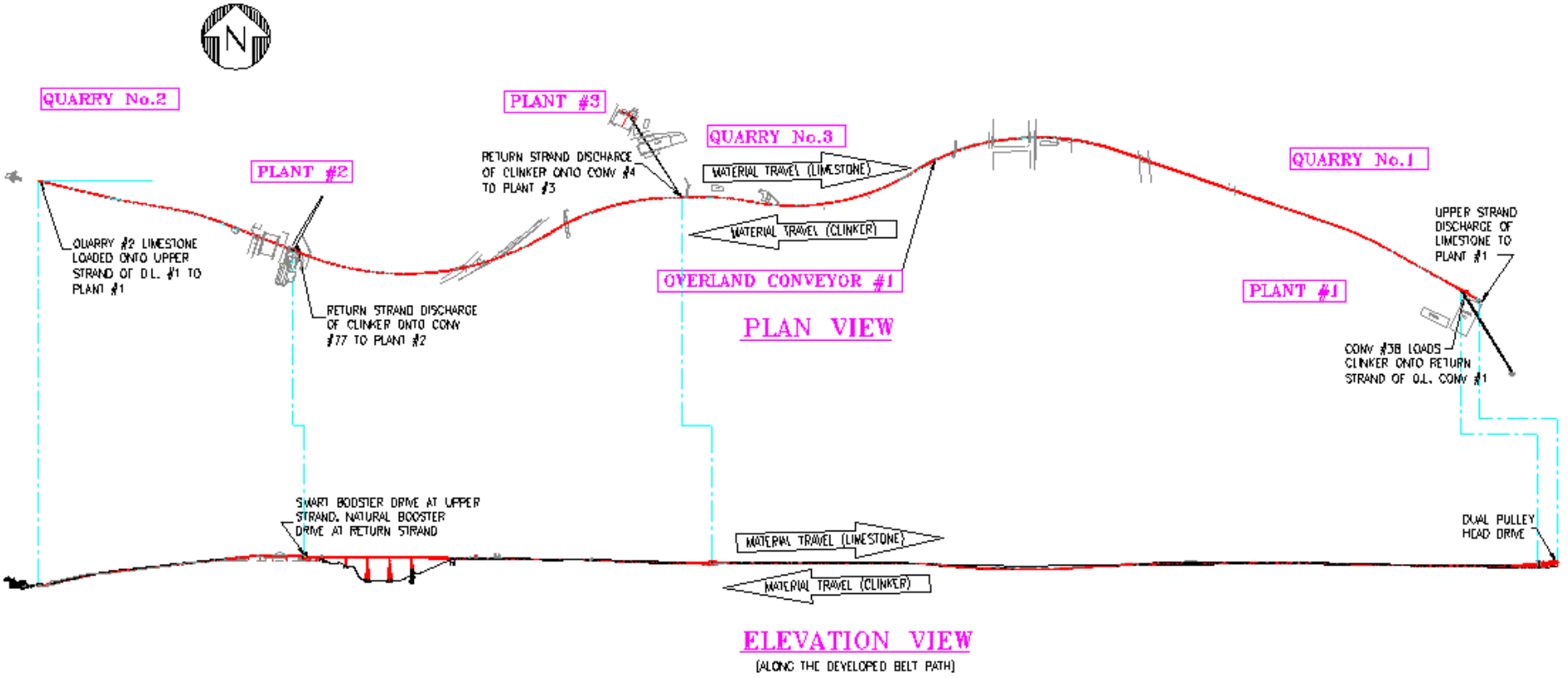


OUR RANGE OF SERVICES

- Technical and economic studies and evaluations
- New Systems
- Upgrade of existing systems
- Plant modifications and field advisory assistance

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997



2.8 KILOMETER, TWO-WAY OVERLAND CONVEYOR

2.8 kilometer overland conveyor for an Eastern USA Cement Company
May be the world's most advanced single flight conveyor system by virtue of the number of simultaneous advanced features, including:

- **Two way conveying**, carrying crushed limestone, on the upper belt strand, and clinker on the return belt strand
- **Horizontally and vertically curving** path featuring 9 horizontal curves, each with compound vertical curves
- **Belt turnovers**, to utilize the thicker belt cover at the carrying side in either travel direction
- **Complete speed control** with AC motors by variable frequency drives
- **Tripper type "Smart" booster** (intermediate) drive at the upper belt strand
- **Tripper type "Natural" booster** drive at the return strand
- **Multiple discharge points** along the return strand

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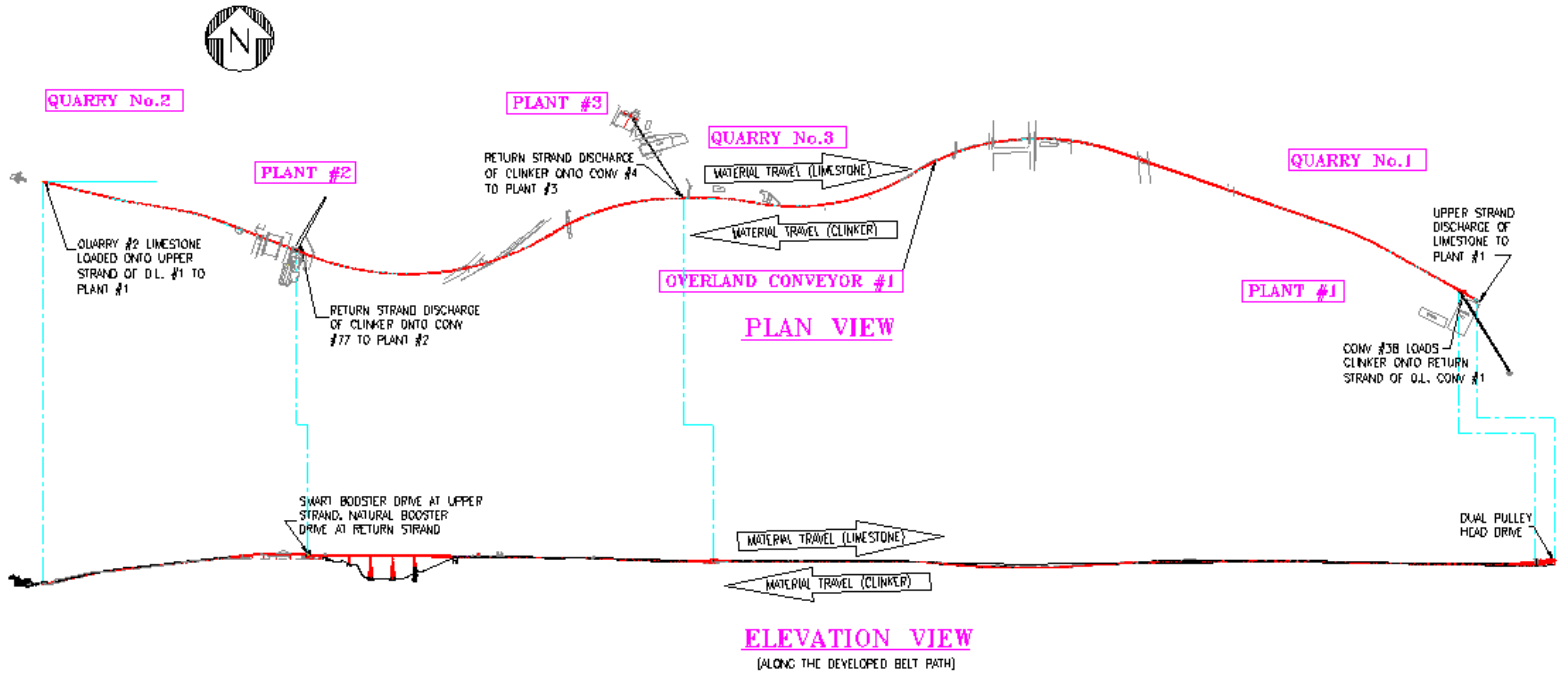
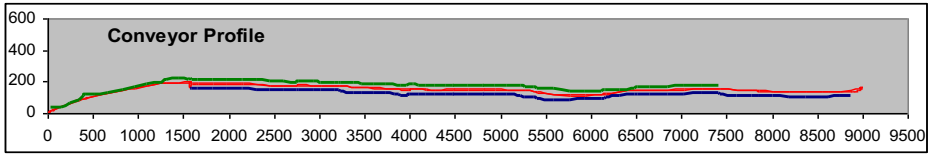
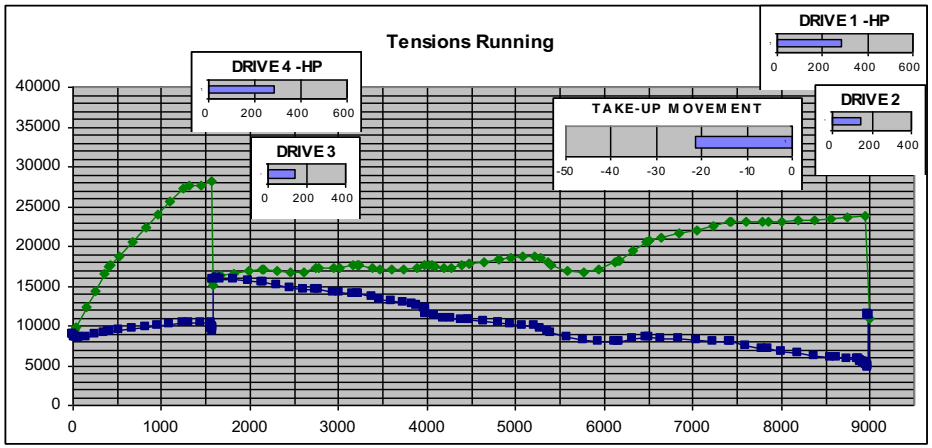


2.8 KILOMETER, TWO-WAY OVERLAND CONVEYOR





DSI ExConTec Analysis quickly reveals the tension and power distribution due to various material flow conditions

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ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

SANDWICH BELT HIGH ANGLE CONVEYORS

- History
- The Technology
- Installations

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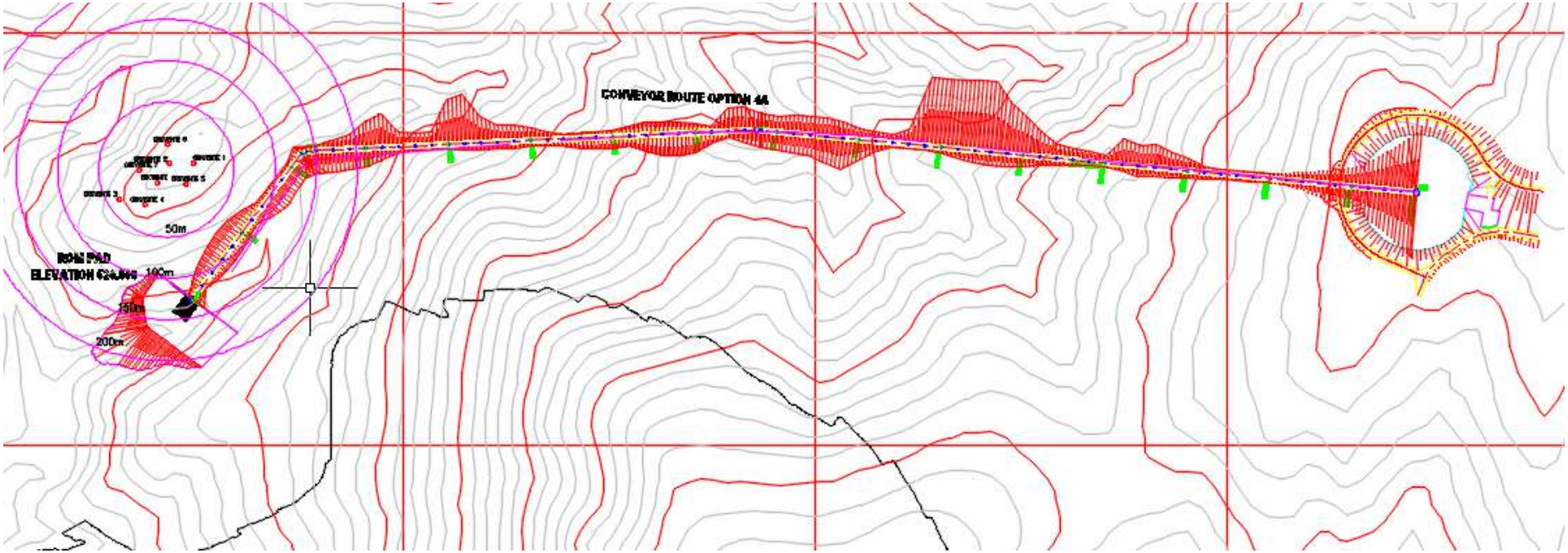
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

ORE CONVEYING PLAN



Design Parameters

Material	Copper, Gold Ore
Bulk Density	1.75 t/cu-m
Size	250mm minus
Design Rate:	1870 t/h

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ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

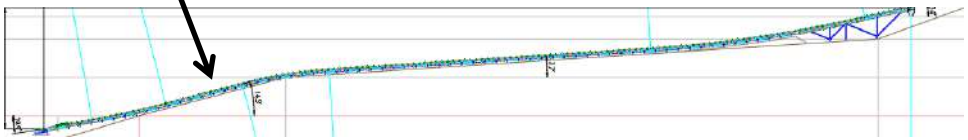
Majdanpek IPCC System, Serbia

Sandwich Conveyor
for
Copper Mine, Eastern Europe

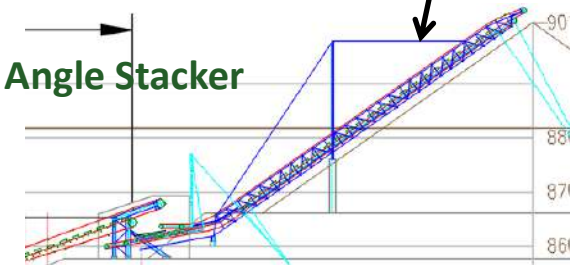
Material	- Copper Ore
- Density	- 2.08 t/cu-m (130 PCF)
- Size	- To 250 mm (10”) minus
Conveying Rate	- 4000 t/h (4409 STPH)
Conveying Angle	- 35.5 degrees
Belt Width	- 2000 mm (78.7”)
Belt Speed	- 2.85 m/s (561 FPM)
Lift	- 93,500 mm (307’)
Drives	
- Top Belt	- 450 kW (600 HP)
- Bottom Belt	- 2x450=900 kW (1200 HP)

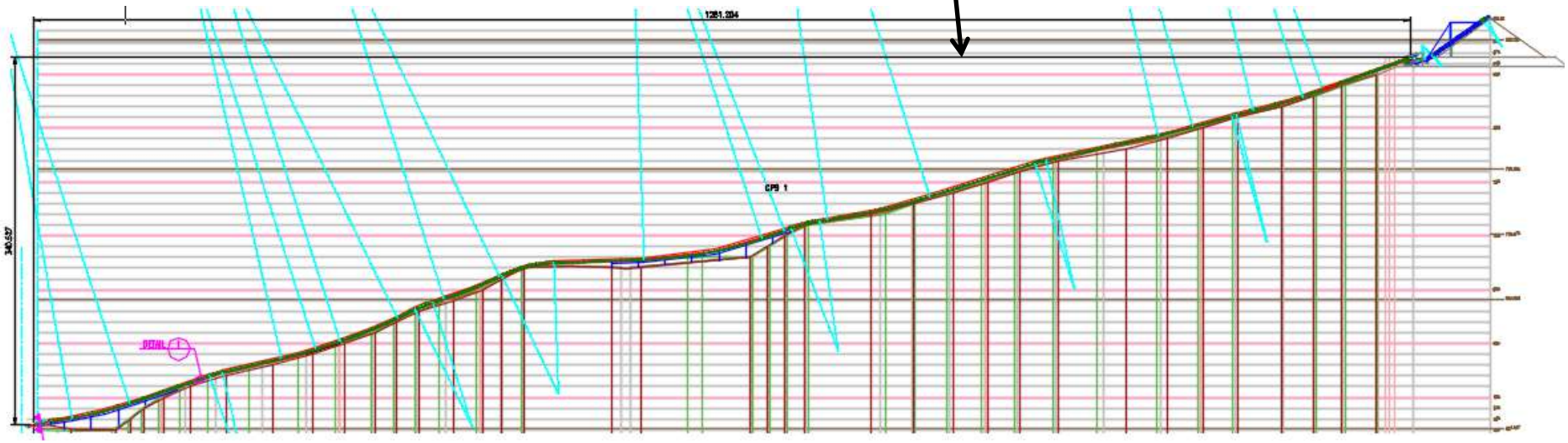
COMPLETE SYSTEM

Sacrificial Conveyor



High Angle Stacker





Main High Angle Conveyor

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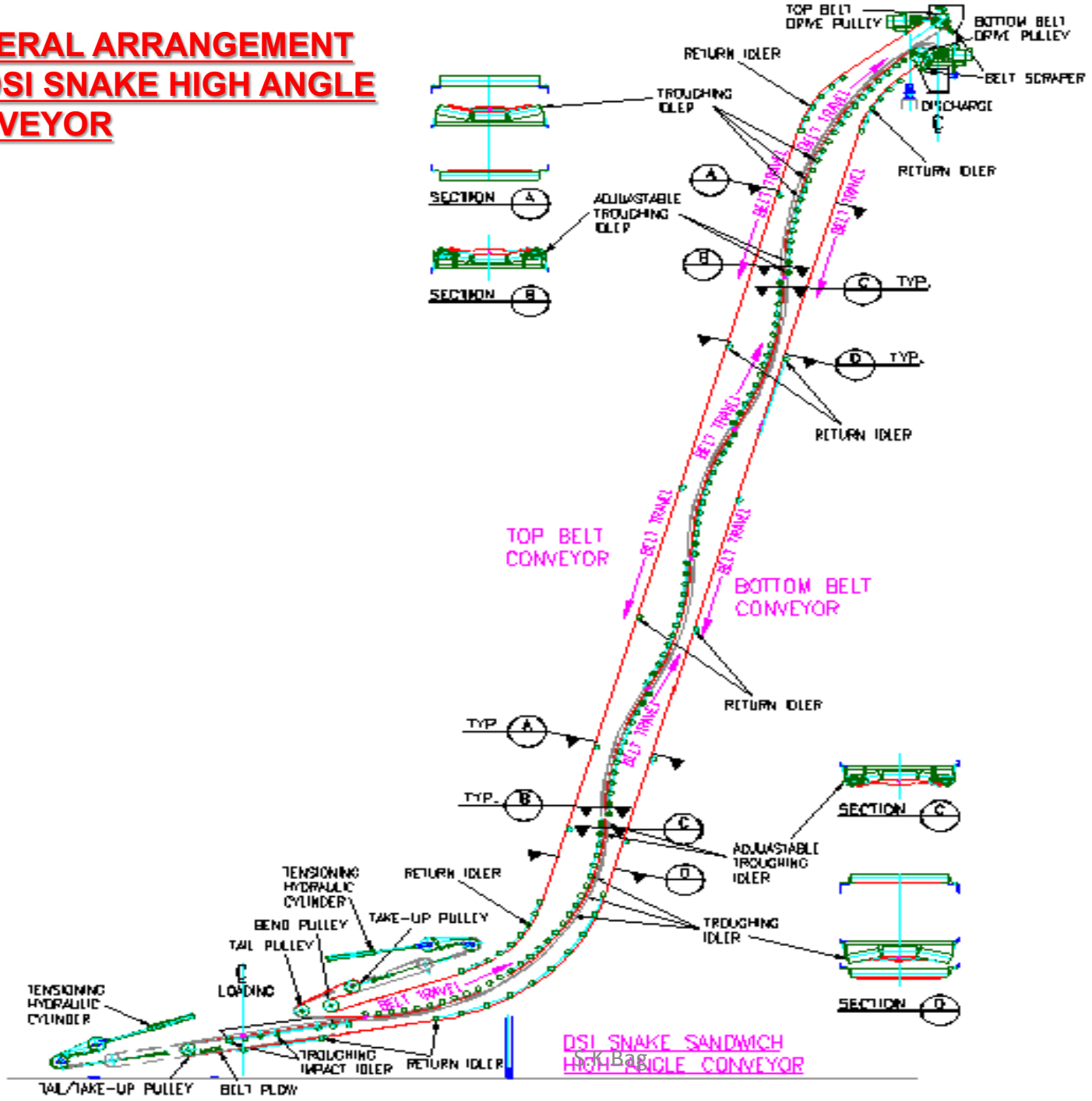
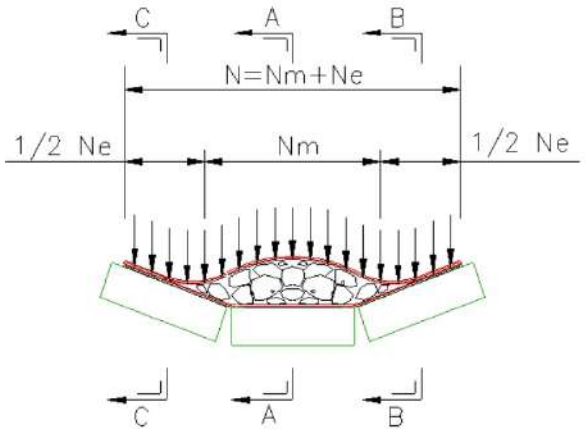
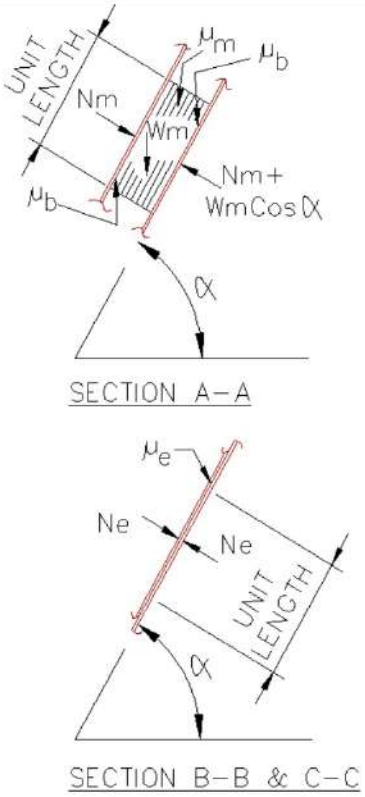
GENERAL ARRANGEMENT OF DSI SNAKE HIGH ANGLE CONVEYOR



SANDWICH BELT PRINCIPLE





α, μ_m, μ_b, **N**, **Wm** are as defined for Sandwich Belt Model #1

Nm = That portion of **N** which bears directly on the conveyed material

Ne = That portion of **N** which bears directly on the edges of the bottom belt

μ_e = Coefficient of friction at the interface of the top and bottom belts

Where: $\mu = \mu_m$ or $\mu = \mu_b$, whichever is the smaller

Hugging pressure N_m:

$$Nm \geq \frac{Wm}{2}\left(\frac{\sin\alpha}{\mu} - \cos\alpha\right)$$

S.K.BAG

α = conveying angle

μ_m = coefficient of friction for bulk material on bulk material

μ_b = coefficient of friction for bulk material on conveyor belt

μ_e = coefficient of friction at the interface of the top and bottom belts

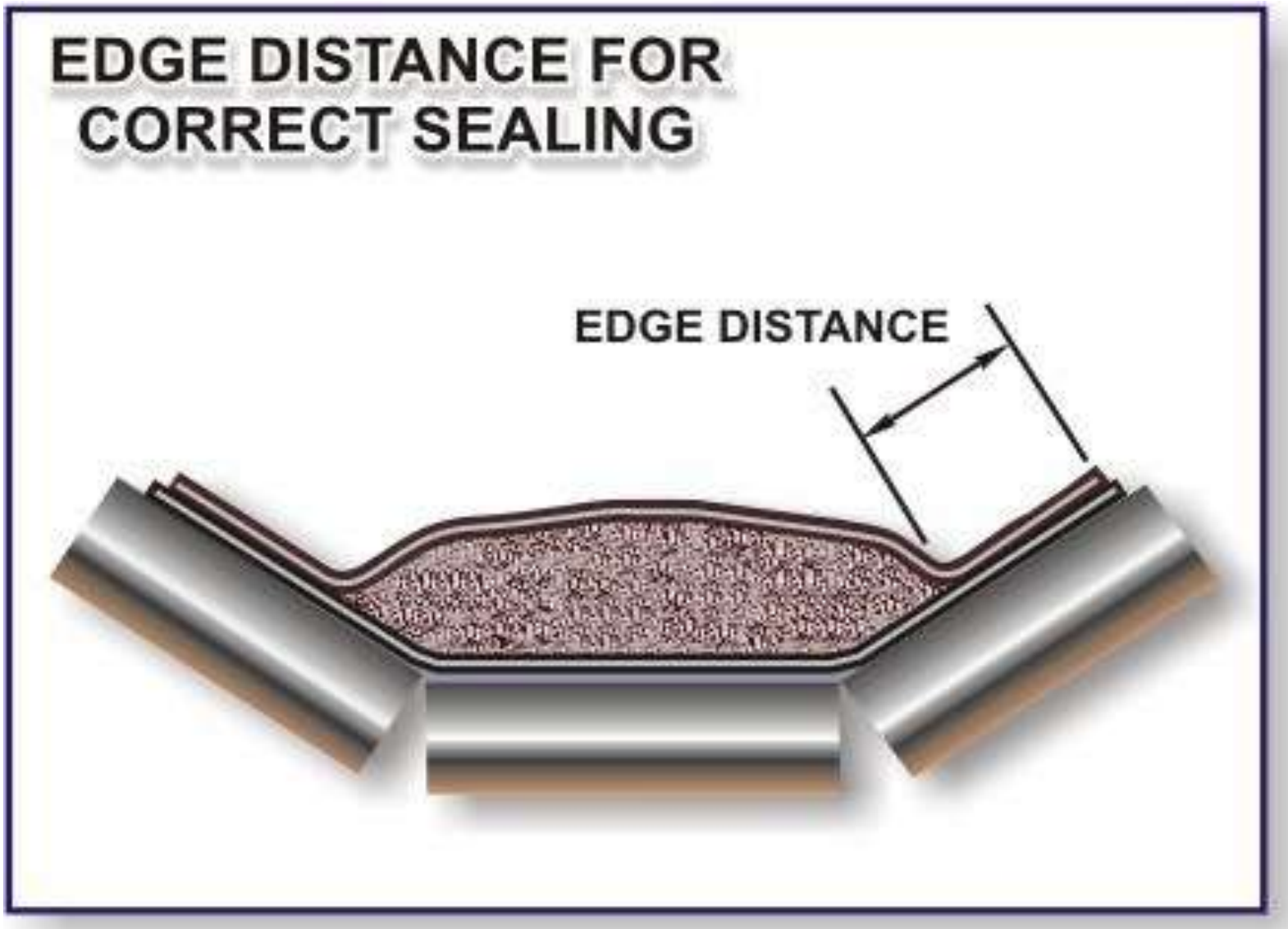
W_m = lineal weight of bulk material

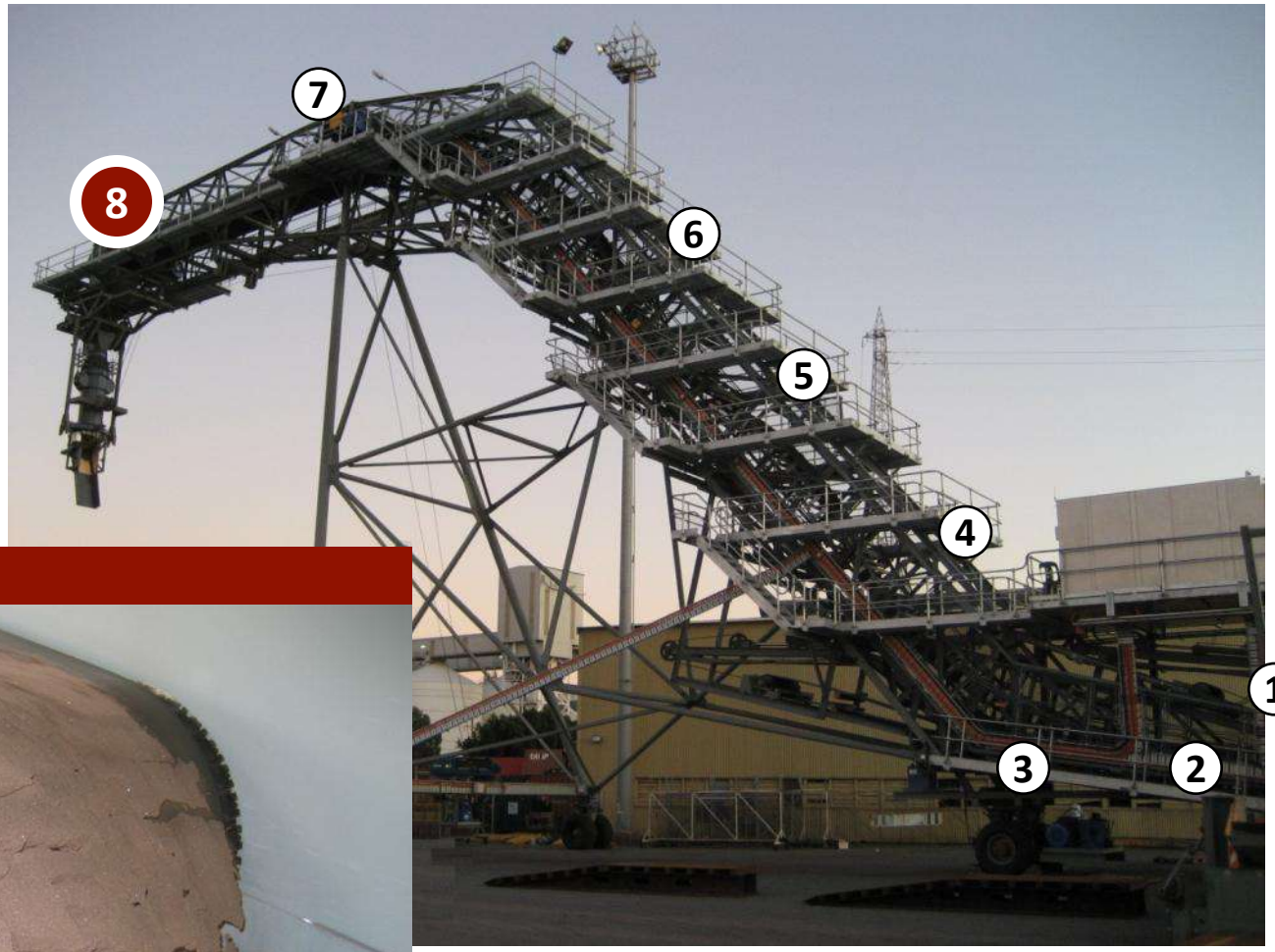
N = normal lineal hugging load exerted by the cover belt

Nm = that portion of N which bears directly on the conveyed material

Ne = that portion of N which bears directly on the edges of the bottom belt

SANDWITCH BELT CONVEYOR





8. Material discharge at head pulley

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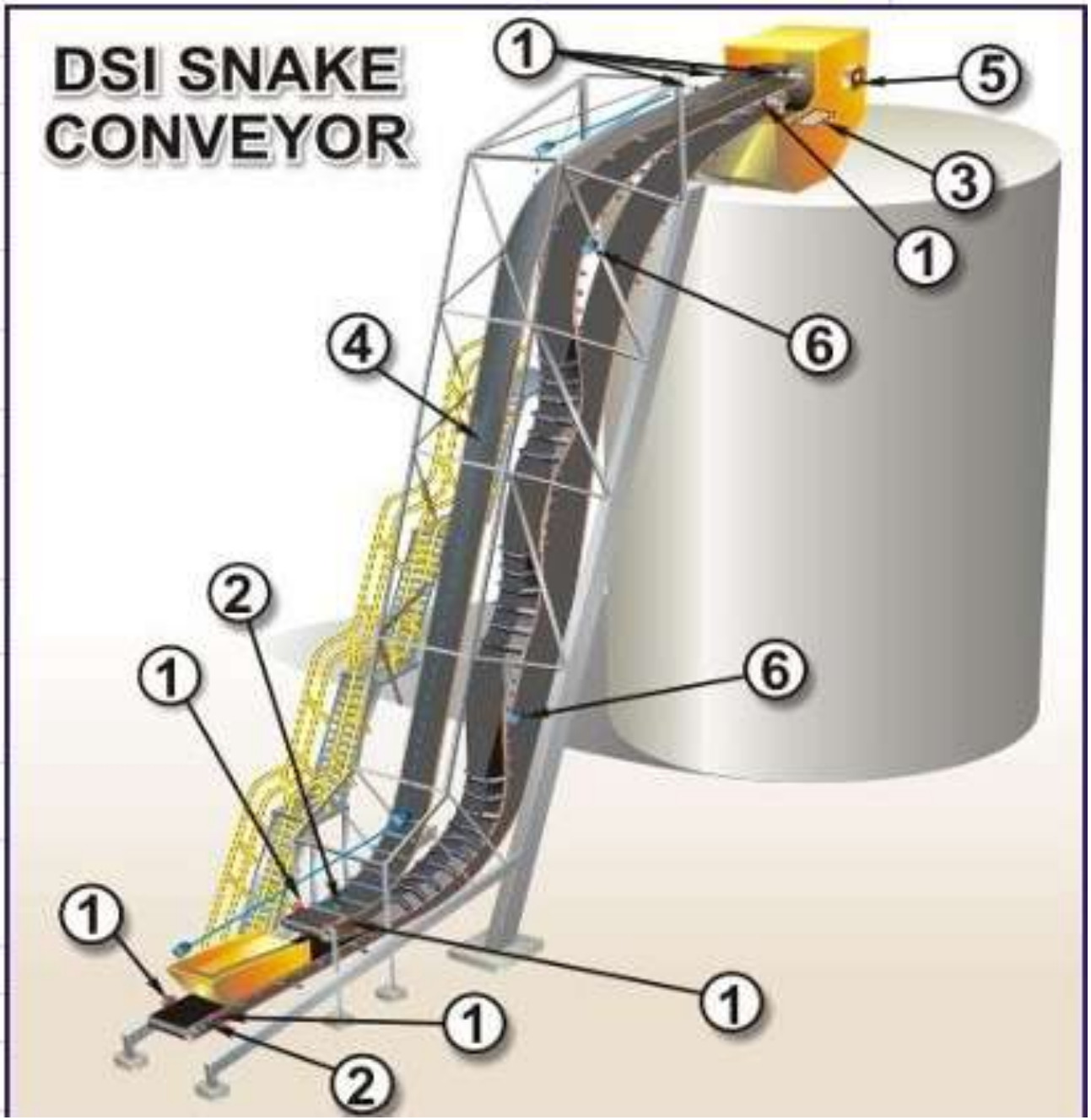
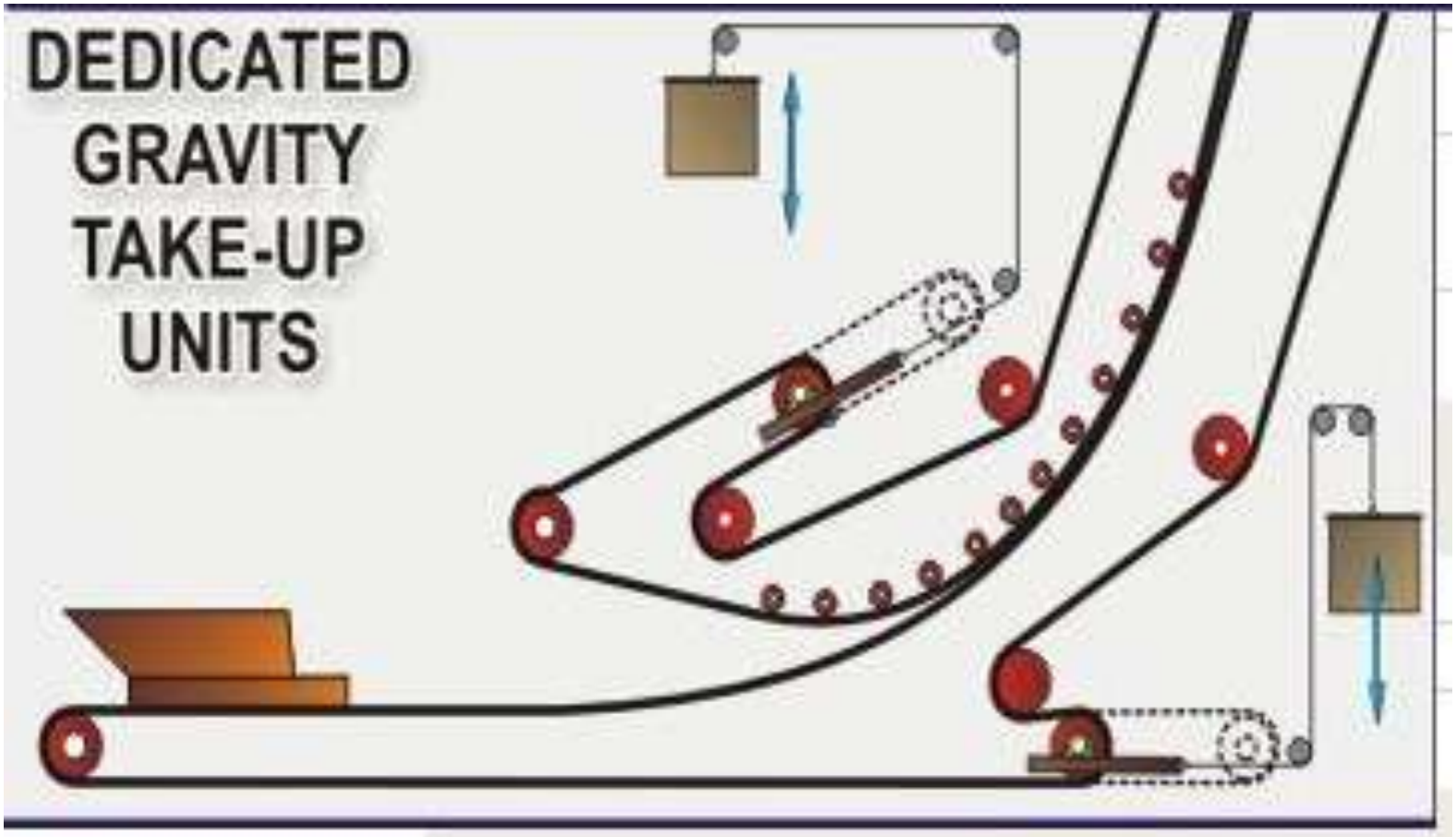
MODULAR SECTION OF SNAKE SANDWICH CONVEYOR

TAKE-UP AND SAFETY DEVICES IN HIGH ANGLE CONVEYORS

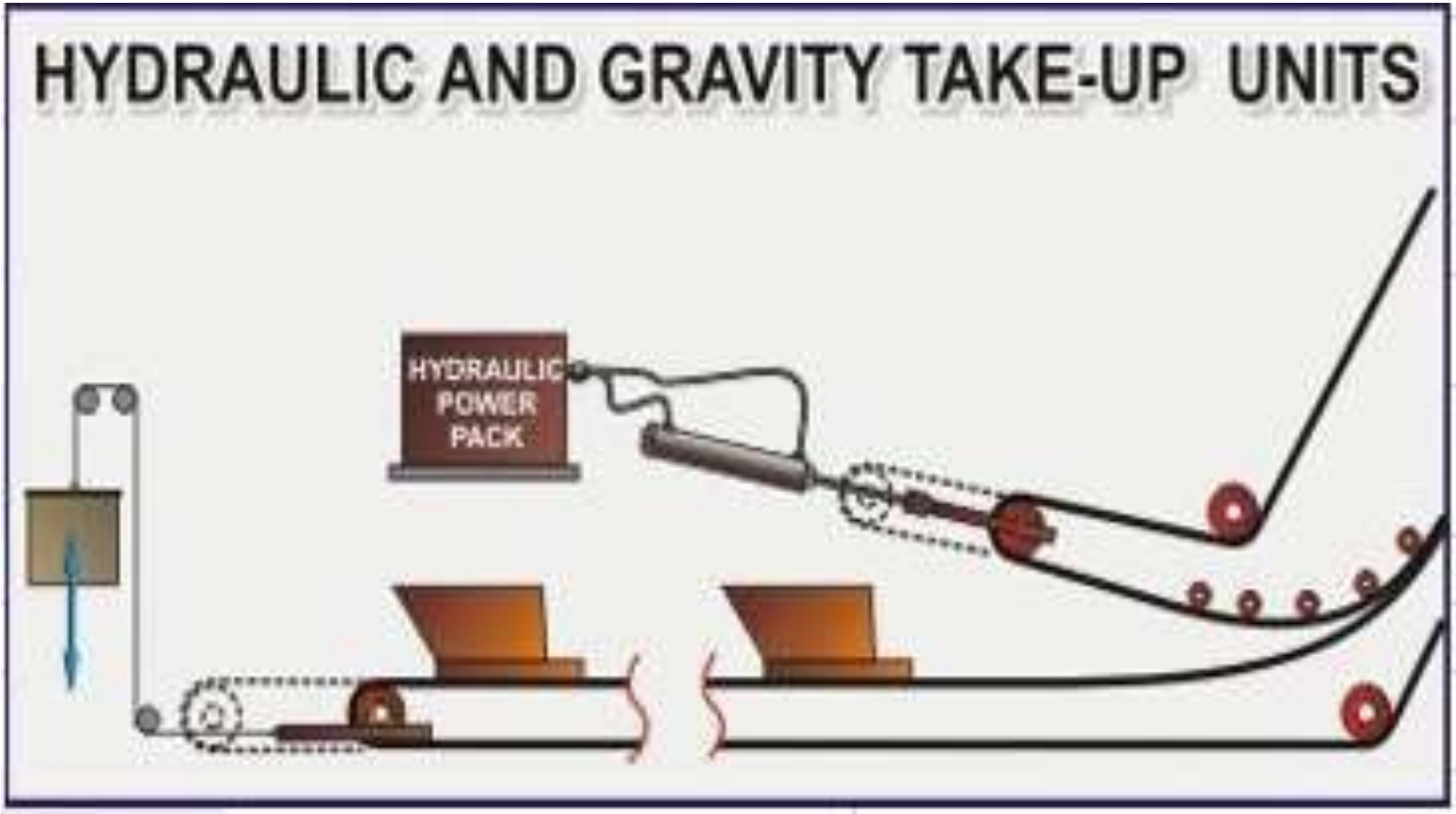

DSI SNAKE
CONVEYOR
1
5
3
1
6
4
2
1
6
1
1
1
2

LIST OF DETECTORS AND SWITCHES PROVIDED IN DSI HIGH ANGLE CONVEYOR SYSTEM

ITEM	DESCRIPTION	FUNCTION WHEN ACTUATED
1	MISALIGNMENT DETECTOR	TRIP BELT IS SERIOIUSLY MISALIGNED
2	UNDER SPEED SWITCH	TRIP DRIVE AND FEED CONVEYOR
3	BLOCKED CHUTE DETECTOR	TRIP DRIVE AND RECEIVING CONVEYOR
4	PULL WIRE AND SWITCH	TRIP DRIVE AND FEED CONVEYOR
5	EMERGENCY STOP	TRIP DRIVE AND FEED CONVEYOR
6	RIP DETECTOR	TRIP DRIVE AND FEED CONVEYOR


DEDICATED
GRAVITY
TAKE-UP
UNITS

HYDRAULIC AND GRAVITY TAKE-UP UNITS



VISIT OUR WEBSITE FOR THE INSTALLATIONS OF VARIOUS TYPES AND CAPACITY

https://dossantosintl.com/installations-i/

PROJECTS FOR READY REFERNCE

VIDEO LINKS OF DSI SANDWICH CONVEYOR

What is DSI Sandwich Belt High Angle Conveyor?

https://youtu.be/COjQeEGfwZY

DSI Sandwich Belt High Angle Conveyor for Paris Metro Tunnelling Project

https://youtu.be/lBMzYHoPz7w

DSI Snake Ship Loader

https://youtu.be/AOtzUInP6cg

DS114 – LAFARGE HOLCIM FOR SPARROW'S POINT

Additional Information

Categories: All industries,Energy & Power,Recycling
Material: Natural gypsum
Density: 0.4 t/cu-m | 75 PCF
Size: 51 mm | 3.0 in
Conveying rate: 122 t/h | 135 STPH
Conveying angle: 85 deg
Belt width: 762 mm | 30 in
Belt speed: 2.03 m/s | 400 FPM
Lift: 23300 mm | 76.0 ft
Length: 61500 mm | 202.0 ft
Top drive power: 19.0 kW | 25.0 HP
Bottom drive power: 19.0 kW | 25.0 HP

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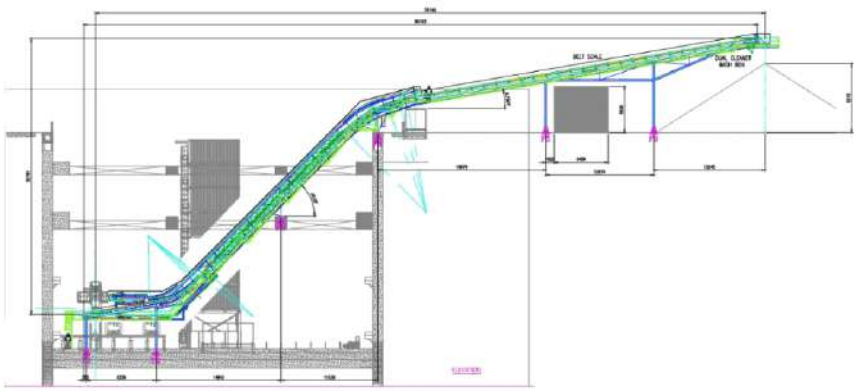
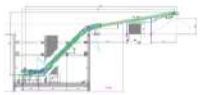
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997





DS116 – SINGAPORE AIRPORT TUNNELING PROJECT

Additional Information

Categories: All industries,Tunneling

Material: Tunnel muck

Density: 1.8 t/cu-m | 114 PCF

Size: 150 mm | 6.0 in

Conveying rate: 800 t/h | 882 STPH

Conveying angle: 45 deg

Belt width: 1200 mm | 47 in

Belt speed: 2.00 m/s | 394 FPM

Lift: 32783 mm | 108.0 ft

Length: 90142 mm | 296.0 ft

Top drive power: 75.0 kW | 100.0 HP

Bottom drive power: 75.0 kW | 100.0 HP

S.K.Bag

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DS108 – PARIS METRO TUNNELING PROJECT

Material: Tunnel muck

Density: 1.6 t/cu-m | 100 PCF

Size: 150 mm | 5.9 in

Conveying rate: 800 t/h | 882 STPH

Conveying angle: 90 deg

Belt width: 1400 mm | 55 in

Belt speed: 3.00 m/s | 591 FPM

Lift: 24647 mm | 80.9 ft

Length: 33521 mm | 110.0 ft

Top drive power: 75.0 kW | 101.0 HP

Bottom drive power: 75.0 kW | 101.0 HP

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DS093 – CONTINENTAL CANADA FOR DOFASCO STEEL PROJECT ALLOYS

Material: Various

Density: 4.2 t/cu-m | 260 PCF

Size: 75 mm | 3.0 in

Conveying rate: 188 t/h | 200 STPH

Conveying angle: 70 deg

Belt width: 914 mm | 36 in

Belt speed: 1.02 m/s | 207 FPM

Lift: 35235 mm | 115.6 ft

Length: 48768 mm | 160.0 ft

Top drive power: 18.6 kW | 25.0 HP

Bottom drive power: 18.6 kW | 25.0 HP

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DS097 – CORTEX RESOURCES FOR SHIPLOADER PROJECT

Material: Titanium Ore

Density: 2.4 t/cu-m | 150 PCF

Size: N/A

Conveying rate: 1000 t/h | 1102 STPH

Conveying angle: 50 deg

Belt width: 1200 mm | 47 in

Belt speed: 2.00 m/s | 394 FPM

Lift: 21805 mm | 71.5 ft

Length: 56656 mm | 185.9 ft

Top drive power: 55.0 kW | 74.0 HP

Bottom drive power: 55.0 kW | 74.0 HP

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ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DS098 – DURO FELGUERA FOR REPSOL REFINERY PROJECT

Material: Green Petroleum Coke

Density: 0.7 t/cu-m | 45 PCF

Size: 80 mm | 3.1 in

Conveying rate: 475 t/h | 524 STPH

Conveying angle: 90 deg

Belt width: 1400 mm | 55 in

Belt speed: 3.50 m/s | 689 FPM

Lift: 21155 mm | 69.4 ft

Length: 32266 mm | 105.2 ft

Top drive power: 45.0 kW | 60.0 HP

Bottom drive power: 45.0 kW | 60.0 HP

DOS SANTOS INTERNATIONAL

ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DSI SNAKE SHIP LOADER

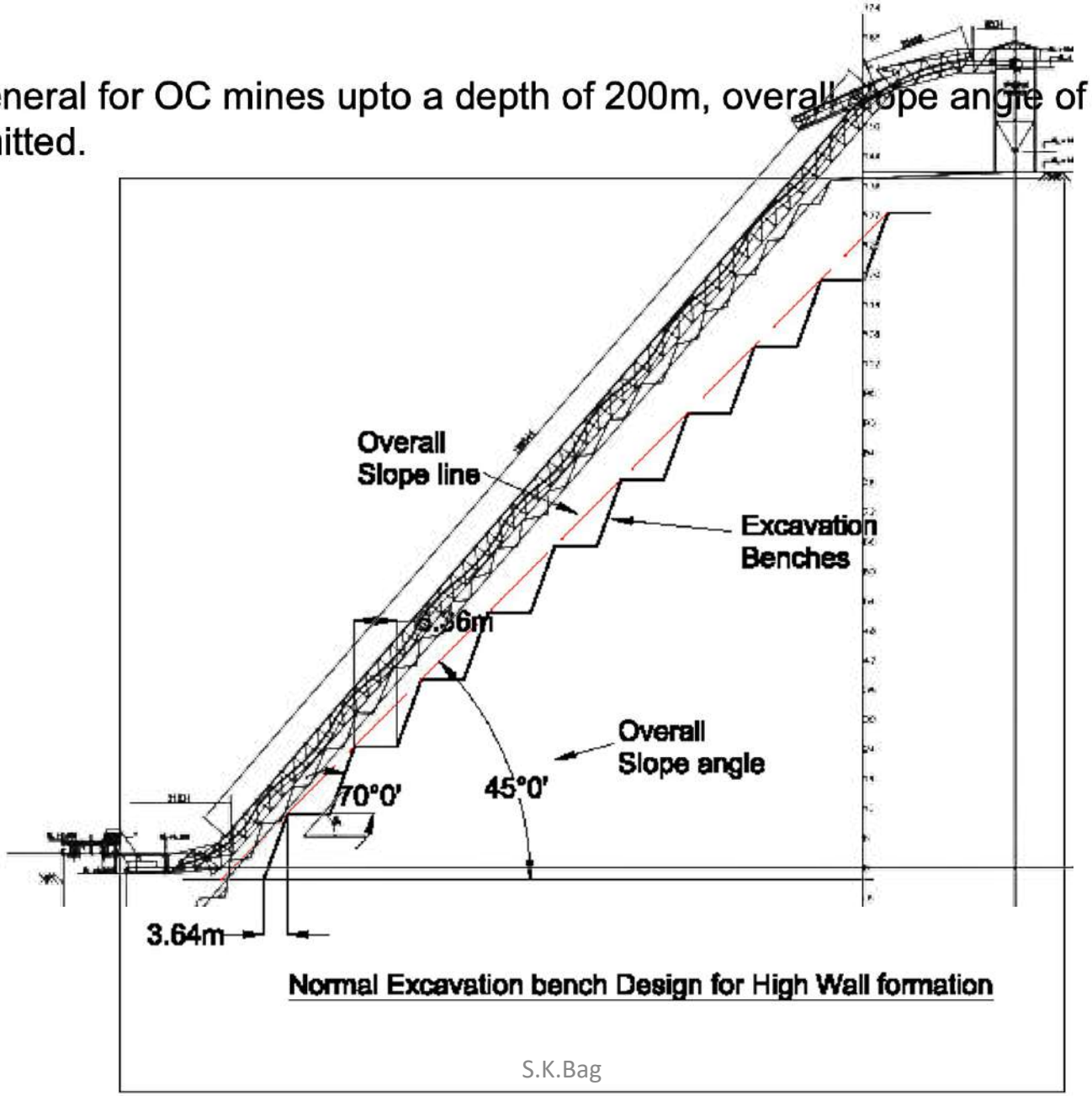
THERE CAN BE FOUR TYPES OF APPLICATIONS OF DSI HIGH ANGLE CONVEYOR AS FOLLOWS

- **OPENCAST MINE**
- **UNDERGROUND MINE**
- **DOWNHILL CONVEYOR**
- **IN CHP FOR LOADING OF SILO**

HIGH ANGLE CONVEYOR IN OPENCAST MINE

DSI HIGH ANGLE CONVEYOR IN SIDE WALL

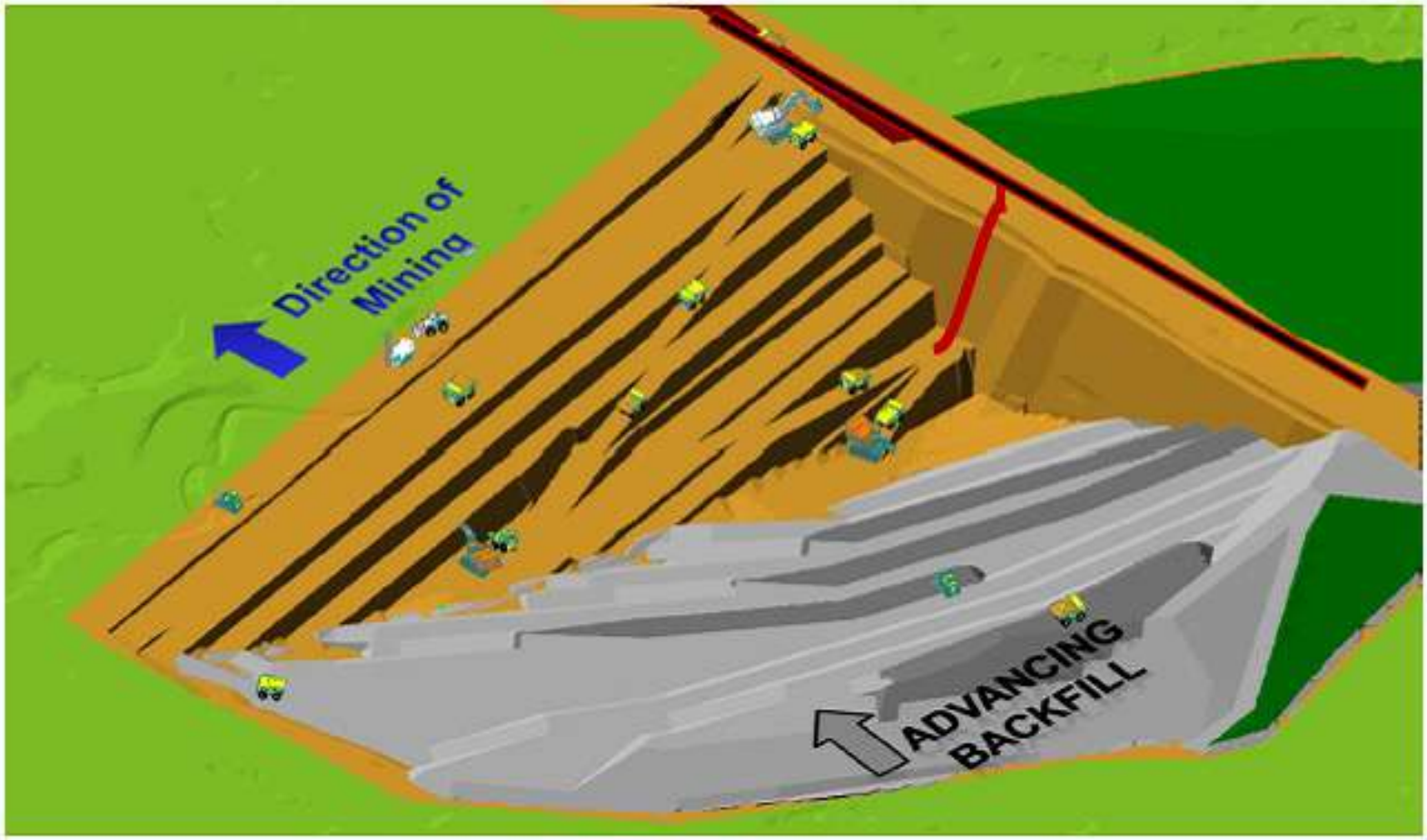
In general for OC mines upto a depth of 200m, overall slope angle of 45^0 is permitted.



Normal Excavation bench Design for High Wall formation

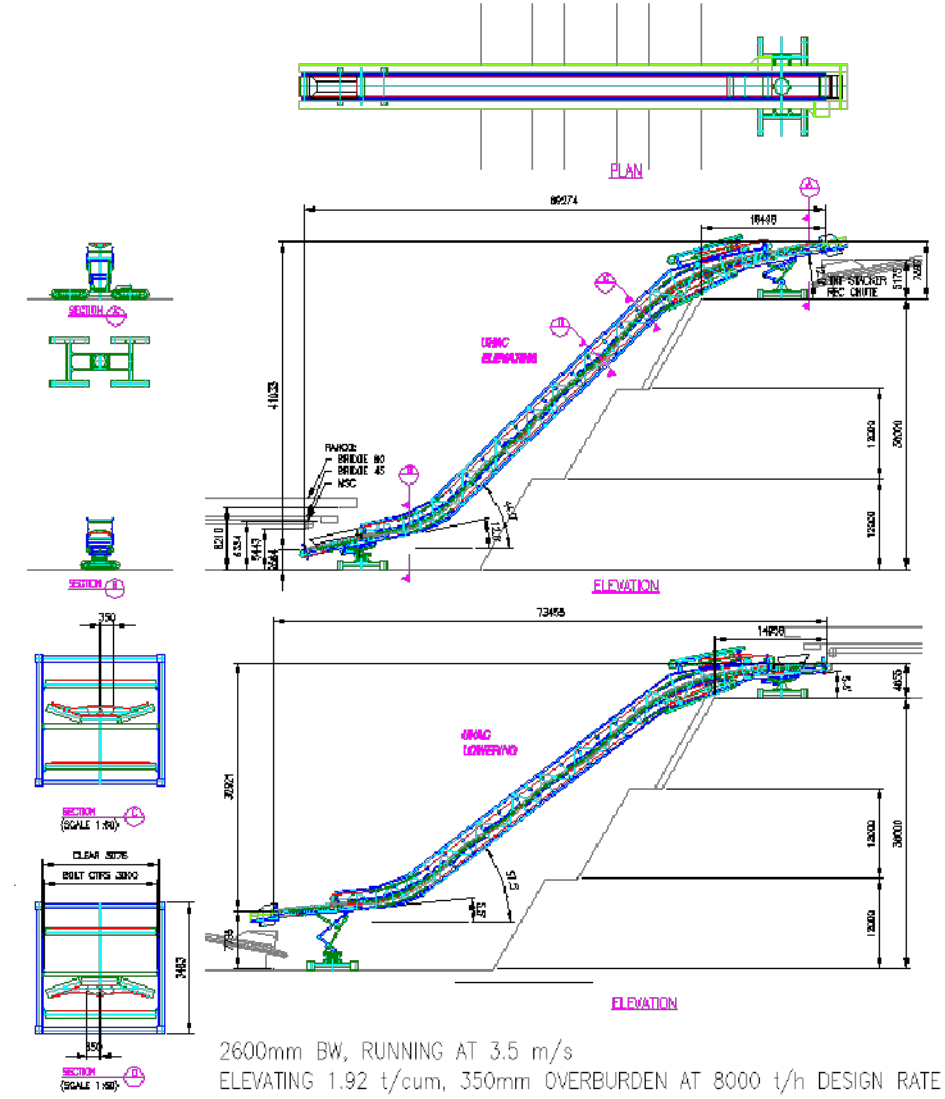
HIGH ANGLE CONVEYOR ALONG HIGH WALL/SIDE WALL IN OPENCAST

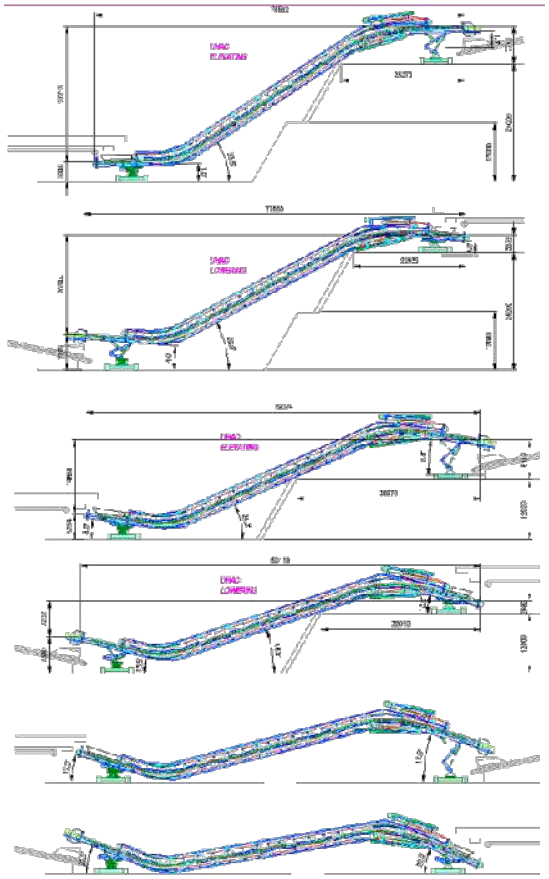
HAC APPLICATION IN INPIT MINE APPLICATION



SHIFTABLE HIGH ANGLE CONVEYOR – UHAC 3 BENCH, 1 BENCH OPERATION

UHAC -Vital Link for IPCC System Western Australia





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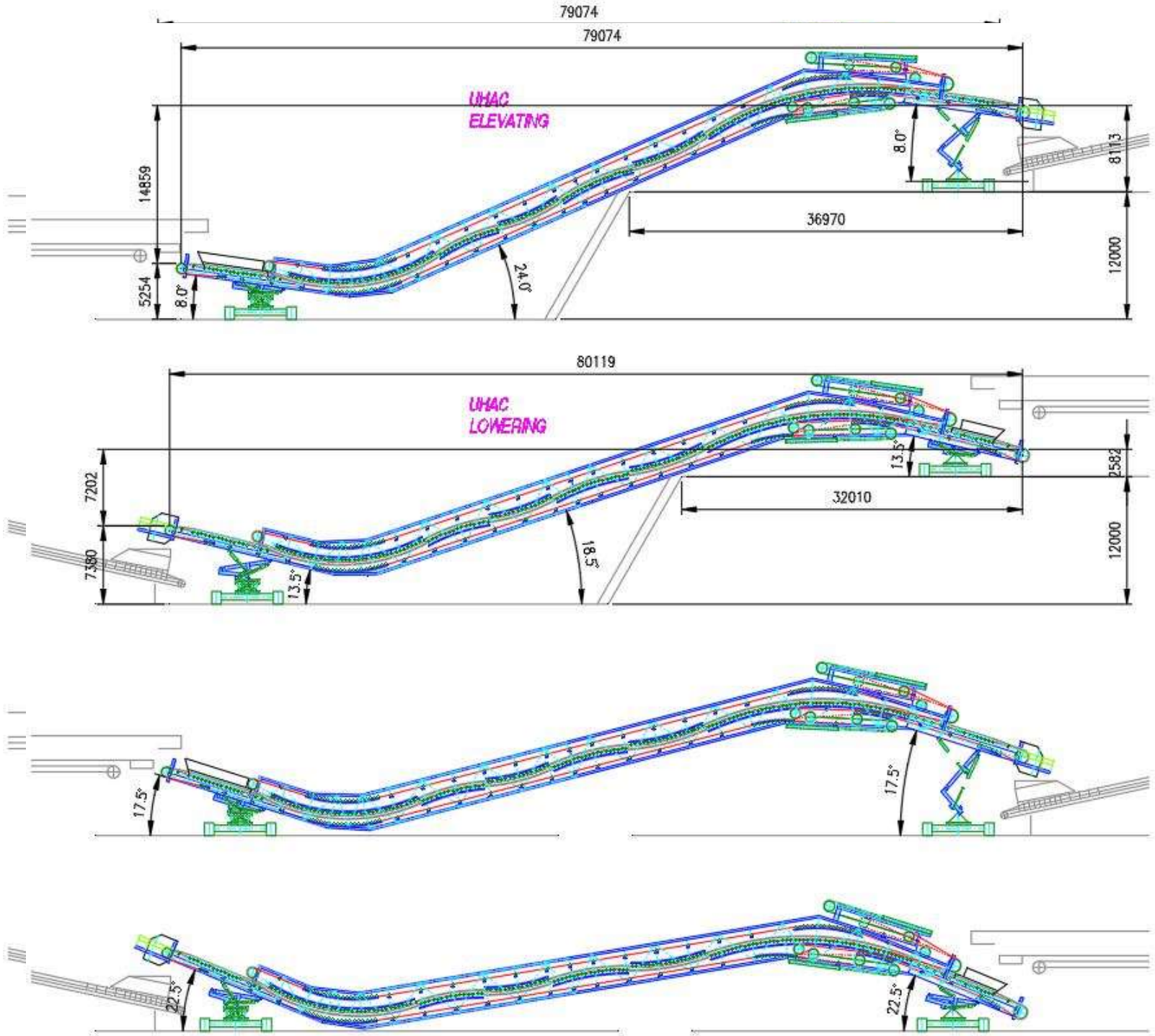
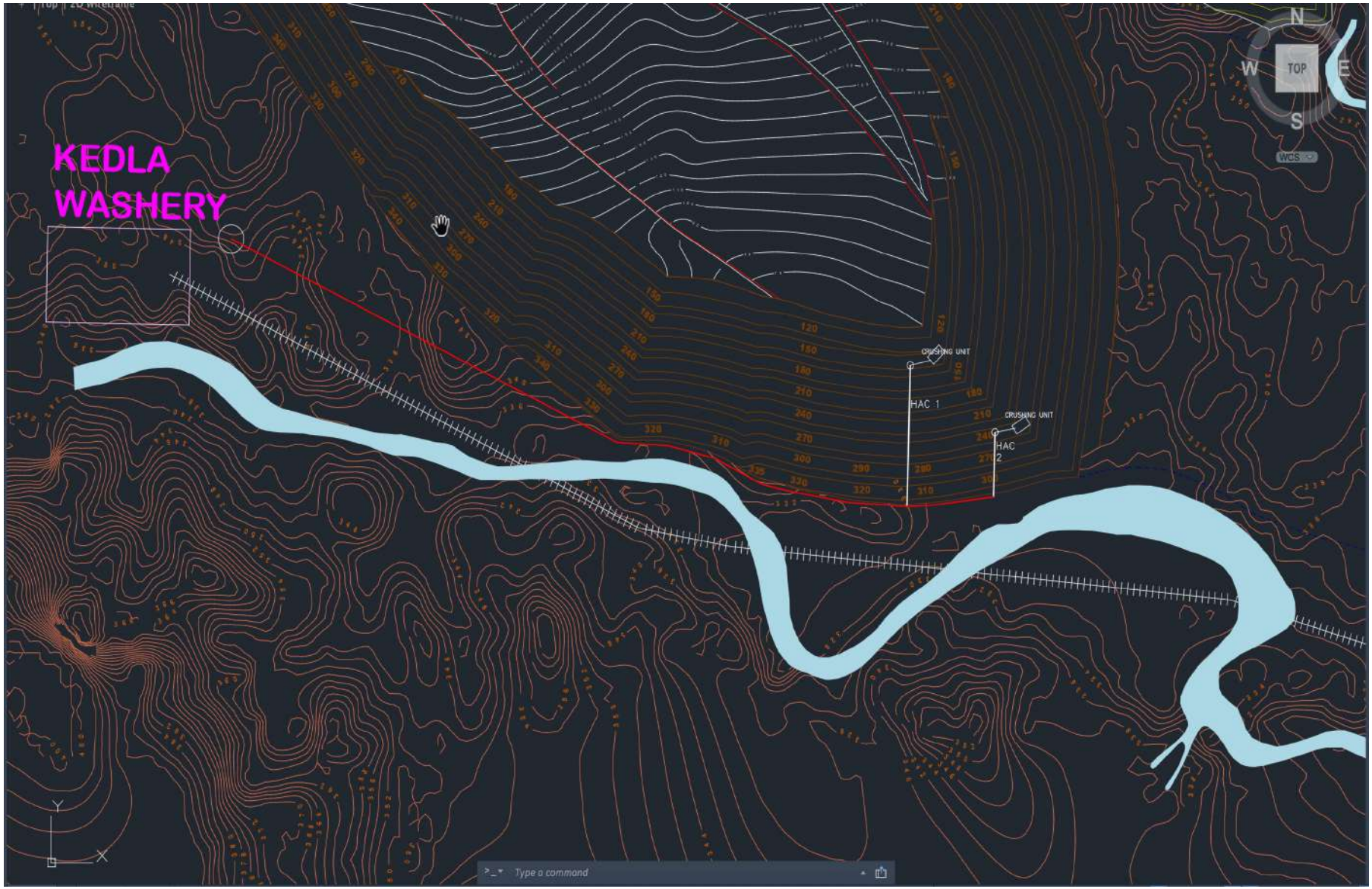
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

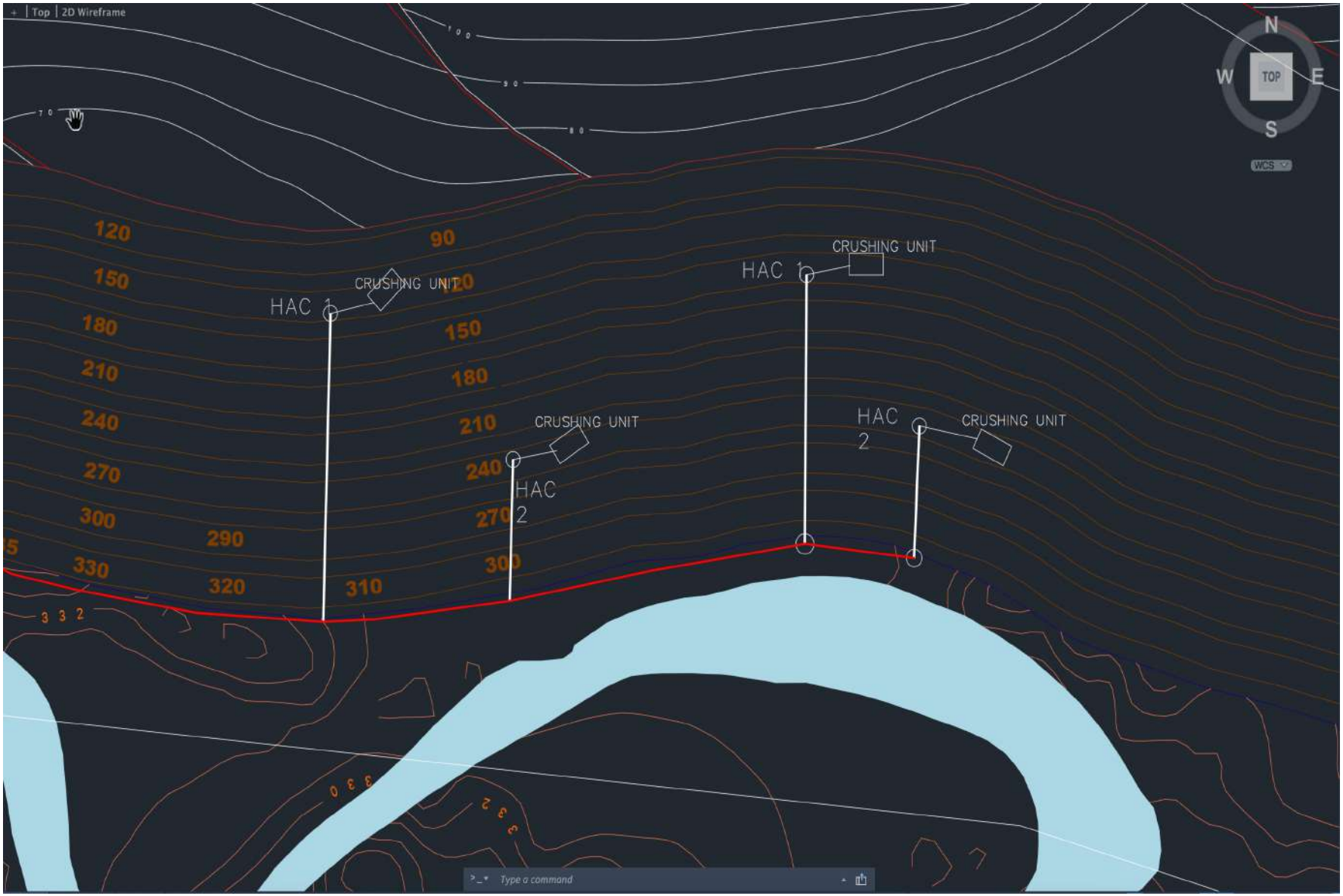

79074
79074
UHAC
ELEVATING
14859
5254
8.0°
24.0°
8.0°
81113
36970
12000
80119
UHAC
LOWERING
7202
7380
13.5°
18.5°
13.5°
2582
32010
12000
17.5°
17.5°
22.5°
22.5°

PROPOSALS BY CMPDI

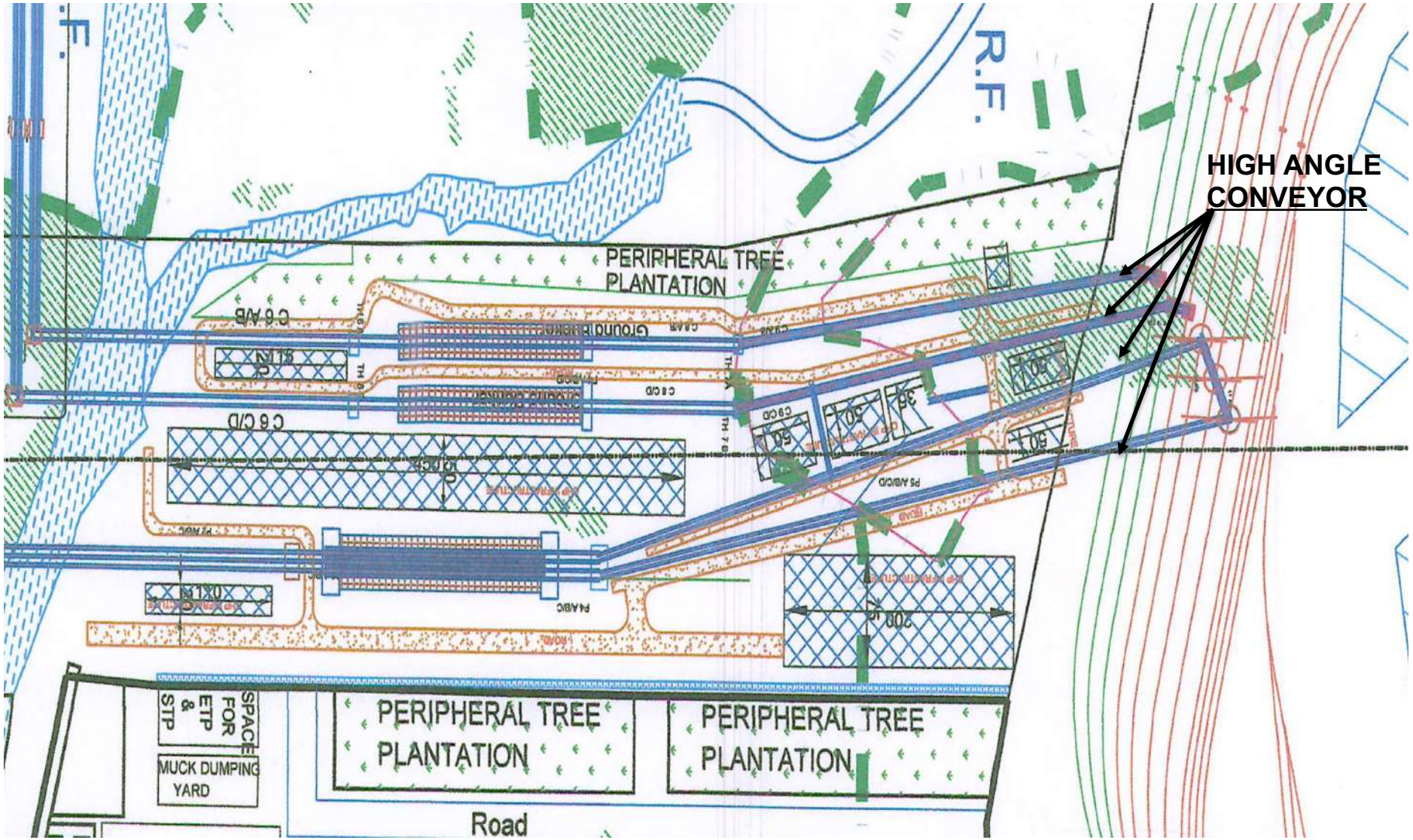
HIGH ANGLE CONVEYOR IN 13 YEAR STAGE PLAN AT KOTRE BASANTPUR



HIGH ANGLE CONVEYOR IN THE FINAL YEAR PLAN – KOTRE BASANTPUR



HIGH ANGLE CONVEYOR AT SIARMAL PROJECT (50 MTPA CAPACITY)



Application of High Angle Conveyor in Deep Opencast Coal Mine (A Case Study) for 15 mtpa non-CIL mine by CMPDI

Application of Steep Angle Conveyor in Deep Opencast Coal Mine (A Case Study)

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Abstract - In India, over 90% of the total coal production is achieved through opencast mining which requires huge quantity of OB removal and mining of coal from the quarry and subsequent transport to the surface. We know that the transport cost is one of the major components in the total cost of production and as the depth of mine increases, along with quantity of material to be transported increases the transport cost rises exponentially. Thus the economics of the mine greatly depends on the economics of the transport system used. Moreover, there is huge inflationary pressure with the fuel costs on the rise.

With the increase in depth of opencast coal mines and for steep quarry batter slope, Steep Angle Conveyor is a solution for transporting coal from quarry floor to surface with better economy and productivity. It is also an eco-friendly, traffic-friendly and space & energy saving solution.

Due to high initial depth and steep quarry batter slope, it is difficult to install conventional conveyor in one Non-CIL opencast project. Therefore, it has been decided for implementation of Steep Angle Conveyor. Economic analysis of Steep Angle Conveyor system vs Dumper system reflects that the capital requirement & cost of production per tonne for Steep Angle Conveyors along with in-pit conveyors and requirement of 60T coal body dumpers have reduced.

Keywords: Steep Angle Conveyor

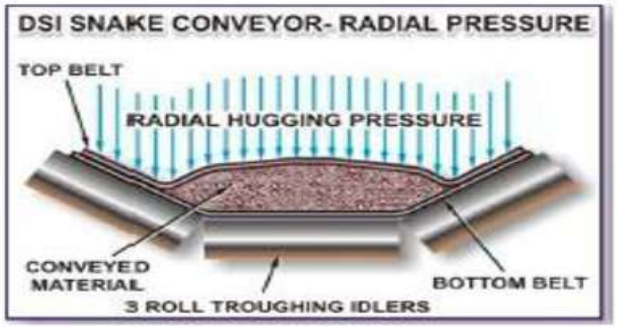
I. INTRODUCTION

At present, there are two main alternatives proposed for the transport system, e.g. (i) truck system and (ii) conventional belt conveyor system. In Indian context, truck based transport system has been a favourite tool for the transportation of OB and coal. However, there is an increasing pressure to restrict the movement of Trucks from environmental point of view, as outlined while issuing Environmental Clearance by MOEF.

Conventional belt conveyors offer a most economical method for transporting bulk materials at recommended inclination angles up to 14 degrees for most common materials. Internal friction development and the induced dynamics of the moving conveyor belt, limit the conveying angle. Conveying angles beyond the angle of internal friction can be achieved by a cover belt which, when pressed against the material, will create a hugging-action to prevent sliding at the contact surface.

Sandwich Belt Conveyors are so named due to the manner in which the material is 'Sandwiched' between two belts before it is inclined at angles up to 70 degrees. Material is 'hugged' by the belts throughout the inclined section to ensure that it does not slide back down the incline, even if the conveyor trips.

A Sandwich Belt Conveyor (Steep Angle Conveyor) consists of two endless belt conveyors that share a common load carrying path. The top and bottom belts are independently driven and tensioned. Along the carrying path, the top and bottom belts are alternately supported against closely spaced troughing idlers. Radial pressure due to belt tension and the curving profile continuously hugs the material that is sandwiched between the two belts. Internal friction is developed and bulk material can be conveyed at any high angle up to 70 degrees or even more.



II. OBJECTIVE

The objective of implementation of Steep Angle Conveying system in conjunction with Surface Miner/In-pit crushing in Indian geo-mining condition is to make coal transportation in opencast coal mines more economic, highly productive, eco-friendly, traffic-friendly and space & energy saving.

III. FACTORS GOVERNING STEEP ANGLE CONVEYOR STRUCTURE

Following are major factors governing a Steep Angle Conveyor structure for conveying material in a mine:

- Whether the dip of the seam permits internal dumping
- Rate of advance of coal face and internal dump
- Rate of deepening the pit
- Whether a dump truck can pass underneath
- Ease of maintenance in a pit environment
- Mine safety, blasting parameters, fire, slope stability, material rolling back etc.
- Dependability to handle large quantities, breakdown analysis/unscheduled maintenance.

IV. STRUCTURAL DESIGNS OF STEEP ANGLE CONVEYOR

After detailed deliberations and discussions with manufacturers of Steep Angle Conveyor, two types of structural designs are approved for a feasible application in a mine.

SINGLE RUN SYSTEM

A single run system as shown in the drawing is suggested for a mine with Steeply to moderately dipping seams. In steeply dipping seams, as there is no inetrnal dumping, Steep Angle Conveyor can be installed at one suitable position and modules can be added to compensate for the depth.

The first position of Steep Angle Conveyor can be at a depth of 90m to 100m to reduce truck fleet. Individual cases must be studied in details to arrive at exact depth. If internal dumping is proposed in a moderately dipping seam, the structure can be shifted to a new location and the shifting period can be scheduled accordingly. Advance preparation at new site will certainly bring down this period significantly.

For coal production, rate should not be less than 4 to 5 Mtpa to justify investment on Steep Angle Conveyor. Life of mine after Steep Angle Conveyor installation should not be less than 18 years.

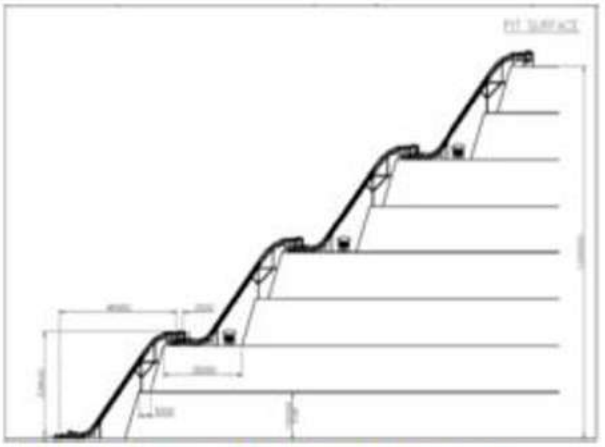
A dumper can pass underneath this structure and staircase is provided alongside Steep Angle Conveyor for maintenance personnels. A hydraulic lift can also be used for maintenance purposes.

It has also been noted that the system is quite robust and with proper maintenance and care it can provide sufficient dependebility to handle large production. The system is equiped with latest sensing system, overlaod protection system, fire sensors to avoid any untoward incidence resulting in unscheduled production loss. A shield is provided to protect vulnerable parts of the structure from fly rocks. Sufficent distance is also maintained from active face.

MODULAR SYSTEM

A modular system is suitable for the mines where frequent shifting is required with advancing internal dump benches. Every unit or module is self-sufficient and can be taken to a new site very quickly. The mode of transport can be crawler mounted at both ends, or

Sandwich Conveyor in a deep Pit



Modular Sandwich Conveyor in a deep Pit

skid mounted to be pushed or pulled by a Dozer. Another popular design to render mobility is by removable crawler pads that can shift multiple units resulting in less investment on crawlers.

Modules can be time phased and are added to compensate for the growing depth of the pit.

Structural changes are possible where these modules can give sufficient clearance to a Truck passing underneath. This is especially important while internal dumping for OB Trucks plying within a closed circuit.

Inherent problem with design shown above is of shifting as support trestles are provided on alternate benches. This can be obviated by a cantilever design made possible by structural engineering.

Another added advantage of modular system of Steep Angle Conveyor is the enhanced dependability. Extra modules with a little additional cost can be fast replaced in the event of unscheduled break down. Certain modifications are required at the place on the bench to accommodate hoppers and tail endings.

It is understood that the Steep Angle Conveyor system will further evolve over time as more experience is gained in working with it. Indigenous practices for operations, shifting, and maintenance, will develop to greater adoptability. Many structural changes are envisaged while implementation phase of Steep Angle Conveyor as new insight emerge.

V. APPLICABILITY

Coal with a lump size of preferably < 200 mm and evenly distributed for effective sandwiching and to avoid material falling back within the sandwich region.

Density-wise suitable for all types of coal and for medium density OB.

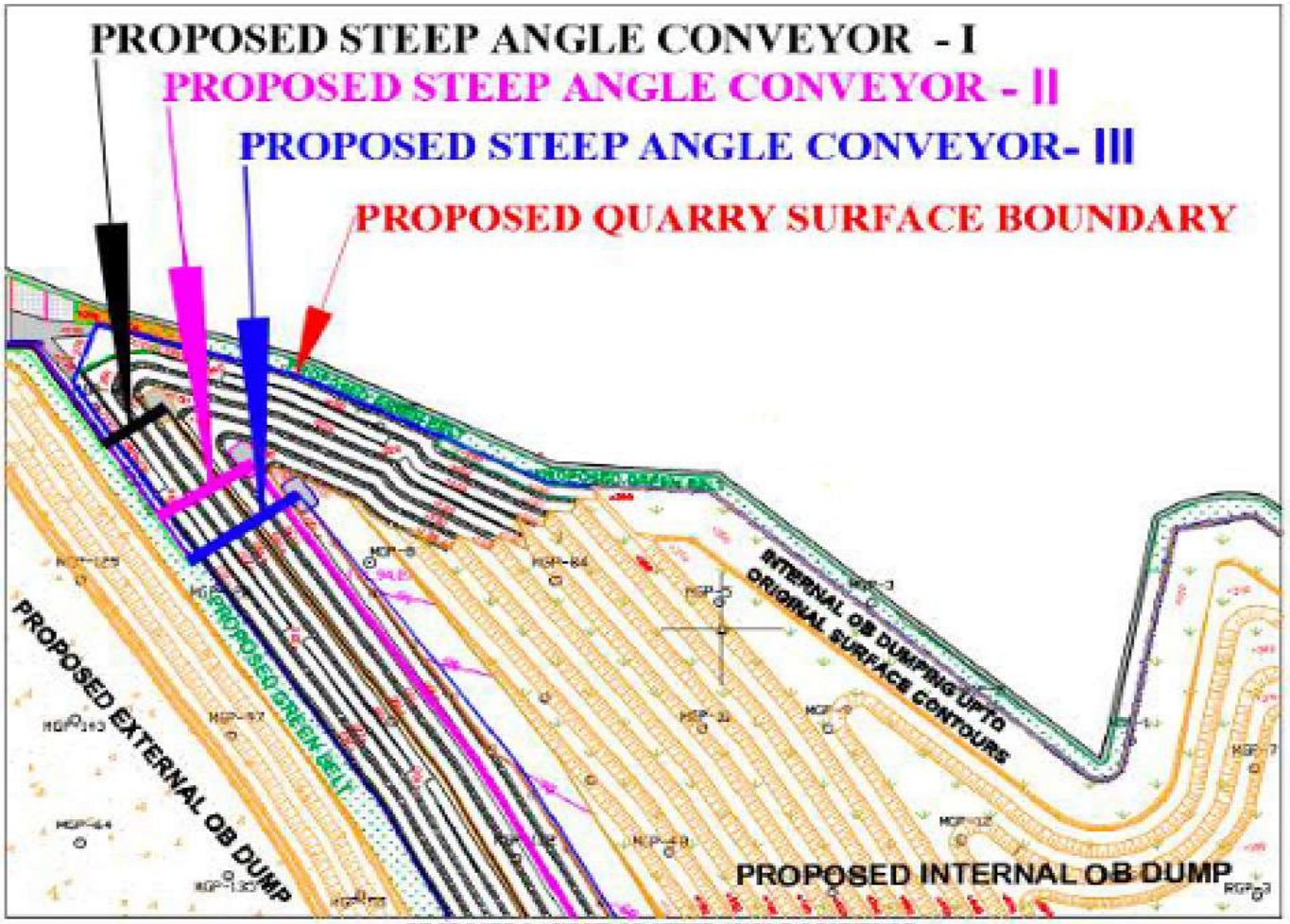
Normal Temperature is recommended for the belt and moisture may cause reduction in frictional force while sandwiching.

The best suitable position for Steep Angle Conveyor is along the side batter. Coal can be brought to the bottom most seam floor for 30 to 50 meters parting and for greater parting thickness, a separate unit can be planned for upper seams.

VI. JUSTIFICATION FOR APPLICATION OF STEEP ANGLE CONVEYOR SYSTEM IN THE PROPOSED OCP

- Due to high initial depth & steep quarry batter, it is difficult to install conventional conveyor.
- It improves economy of the mine.
- It is a highly productive system.
- It is an eco-friendly system.
- It is a traffic-friendly system.
- It is a space saving system.
- It is an energy saving system.
- It is a solution for transporting coal from quarry floor to surface at higher depth.

894173/2021/O/o HEAD OF OC DIVISION, CMPDI HQ



PROPOSED LAYOUT OF STEEP ANGLE CONVEYOR

Application of High Angle Conveyor in Deep Opencast Coal Mine (A Case Study) for 15 mtpa non-CIL mine by CMPDI

894173/2021/O/o HEAD OF OC DIVISION, CMPDI HQ

XI. CONCLUSION & RECOMMENDATION

CONCLUSION

From the tables showing operating costs for Steep Angle Conveyor system and Dumper system, it is evident that the Steep Angle Conveyors along with in-pit conveyors has reduced the 60T coal body dumpers by 87 nos. This has also reduced capital expenditure by about Rs.25 crores and cost of production by about Rs.78 per tonne.

In the proposed OCP, due to high initial depth, steep quarry batter and suitable geo-mining conditions, Steep Angle Conveyor has been proved cheaper, more productive, eco-friendly, traffic-friendly and space & energy saving solution for transporting coal from quarry floor to surface.

RECOMMENDATION

Steep Angle Conveyor is a new technology for Indian Coal Industry. For the success of Steep Angle Conveyor system, strict compliance of Project Report provisions, disciplined work culture, scheduled maintenance, condition-based monitoring and adherence to provisions of DGMS guidelines for the safety of men & machineries are highly recommended.

Proposal from Adani Natural Resources for High Angle Conveyor for Gare Palma II, planned by CMPDI

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On 7/28/2022 3:12 AM, Pallab Mukherjee wrote:

Dear Sir,

Greeting from Adani Enterprises Ltd.,

Currently, we are in the process of installing High angle conveying from bottom of pit to ground surface at our Gare Pelma-II Project.

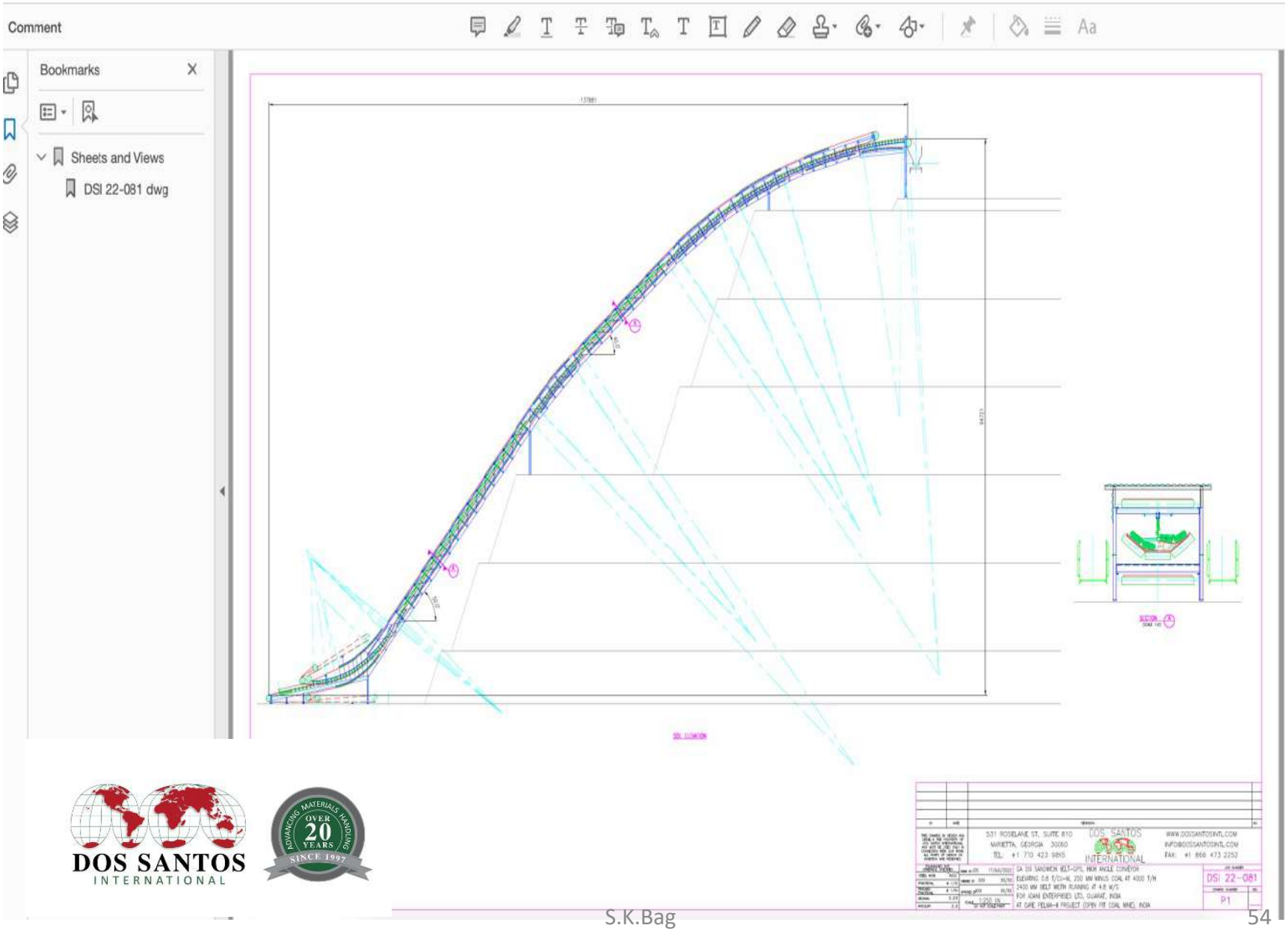
Operating Parameters:

1. Material application – Coal
2. System capacity – 4000 TPH (Rated) (If maximum capacity of4000 TPH is not available, then please consider 2 working conveyors.)
3. Lump Size – (-) 100 (10 – 15% of (+) 100 mm Lump shall be considered in design)
4. Bottom of Pit – EL (+) 191 M
5. Ground level at surface – EL (+) 289 M (Please consider EL (+) 295 as floor level of discharge high angle conveyor)
6. Offset distance between head end and tail end - 109 m
7. Density - 0.8 Mt/Cum
8. Moisture Content – Please consider typical for Indian coal
9. High angle conveyor taking feed from Apron Feeder / Belt Conveyor of 4000 TPH Capacity / 2 x 2000 TPH Capacity as required.
10. High Angle Conveyor discharging to surface Belt conveyor.
11. Mining by surface miner.

12. Snap shot for the arrangement is attached herewith for your reference.

As we find out you are a potential supplier in this regard, request to furnish us technical and commercial offer at the earliest which should include but not limited to:

Layout proposed by Dos Santos, USA

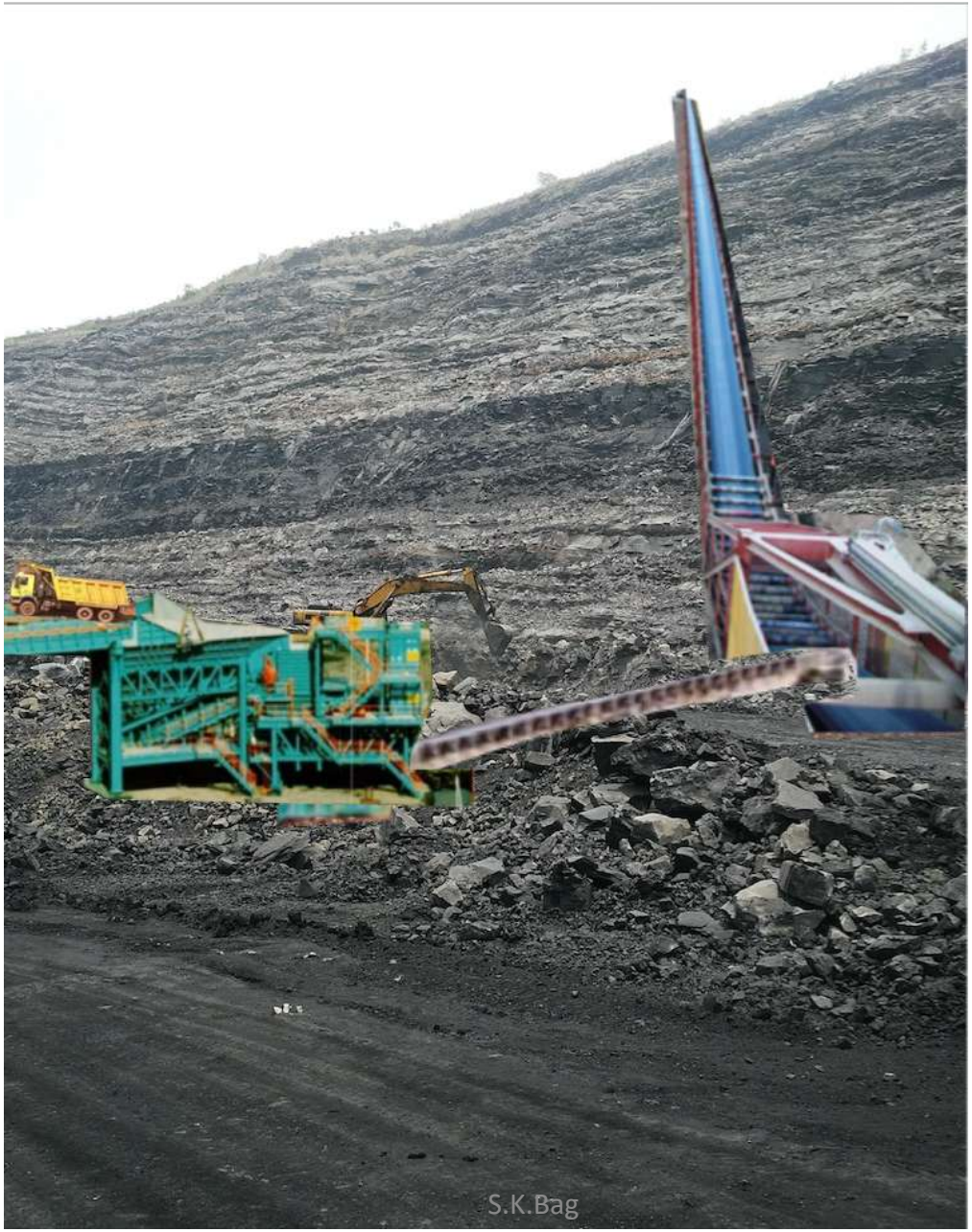


CASE STUDIES BY DOS SANTOS INTERNATIONAL IN INDIA

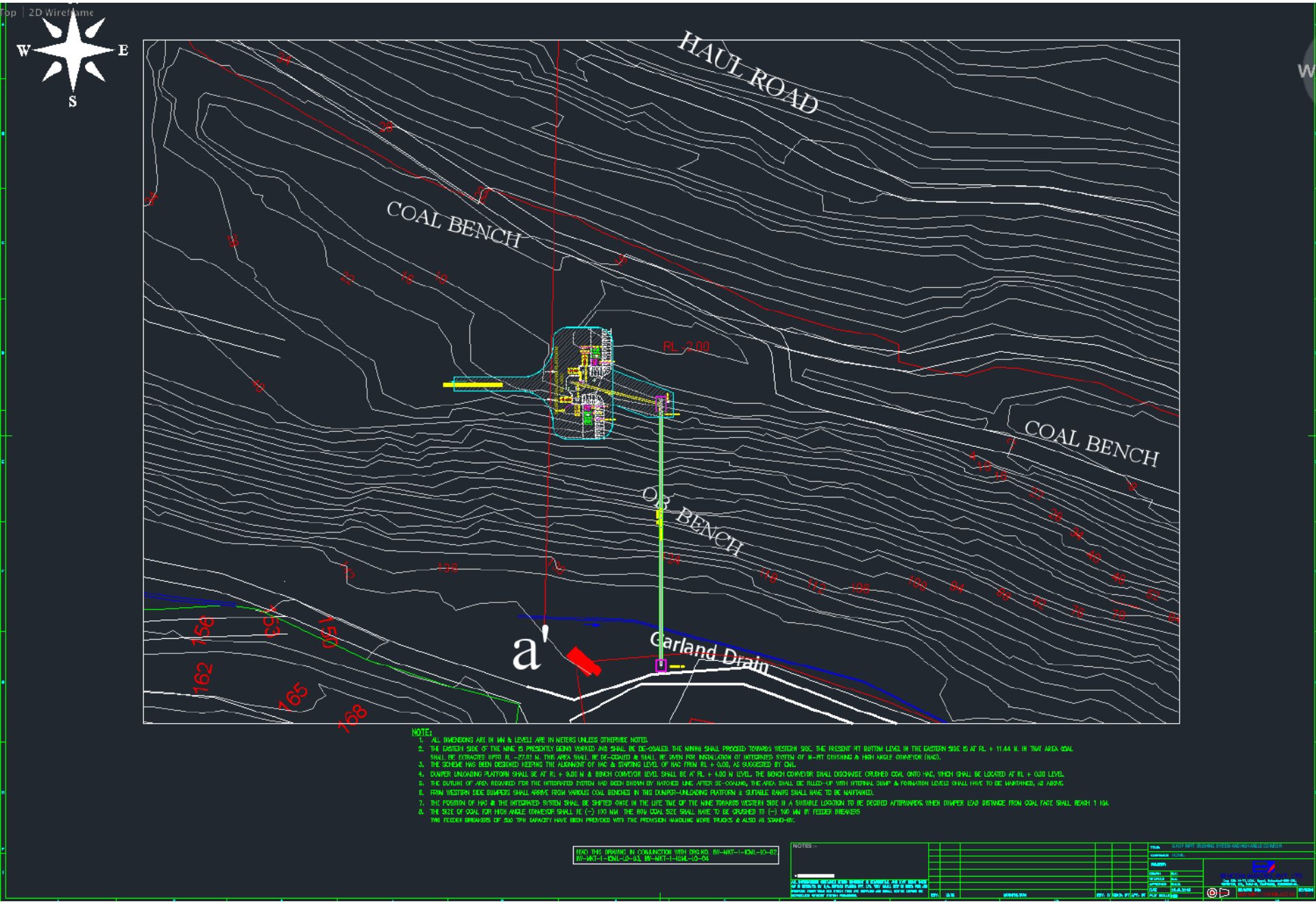
CASE STUDY FOR OPENCAST APPLICATION AT SARISHATHALI MINE AS REQUESTED BY CESC

PRESENT HIGHWALL IN ‘OB’

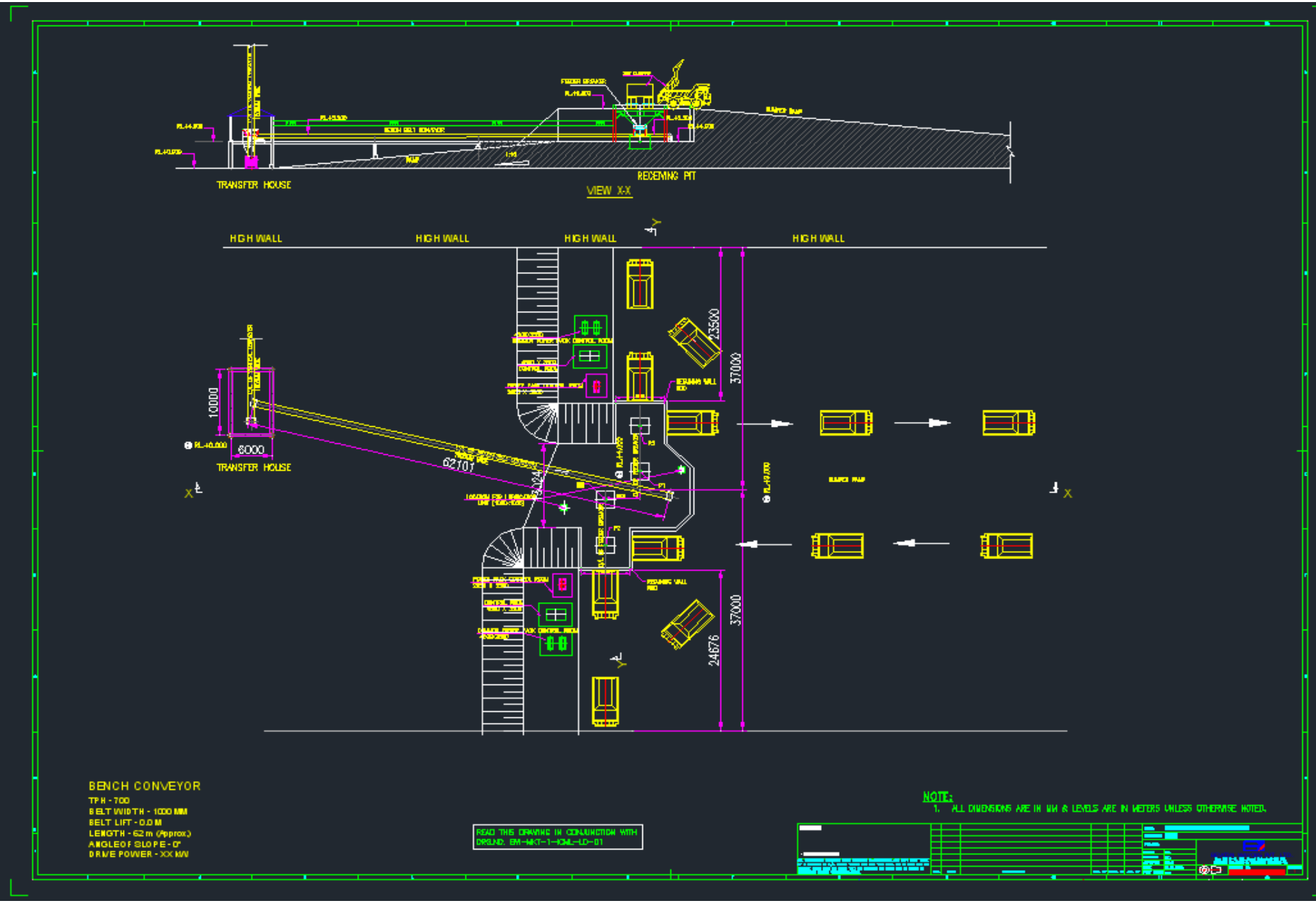
HOW DSI SNAKE CONVEYOR SHALL LOOK



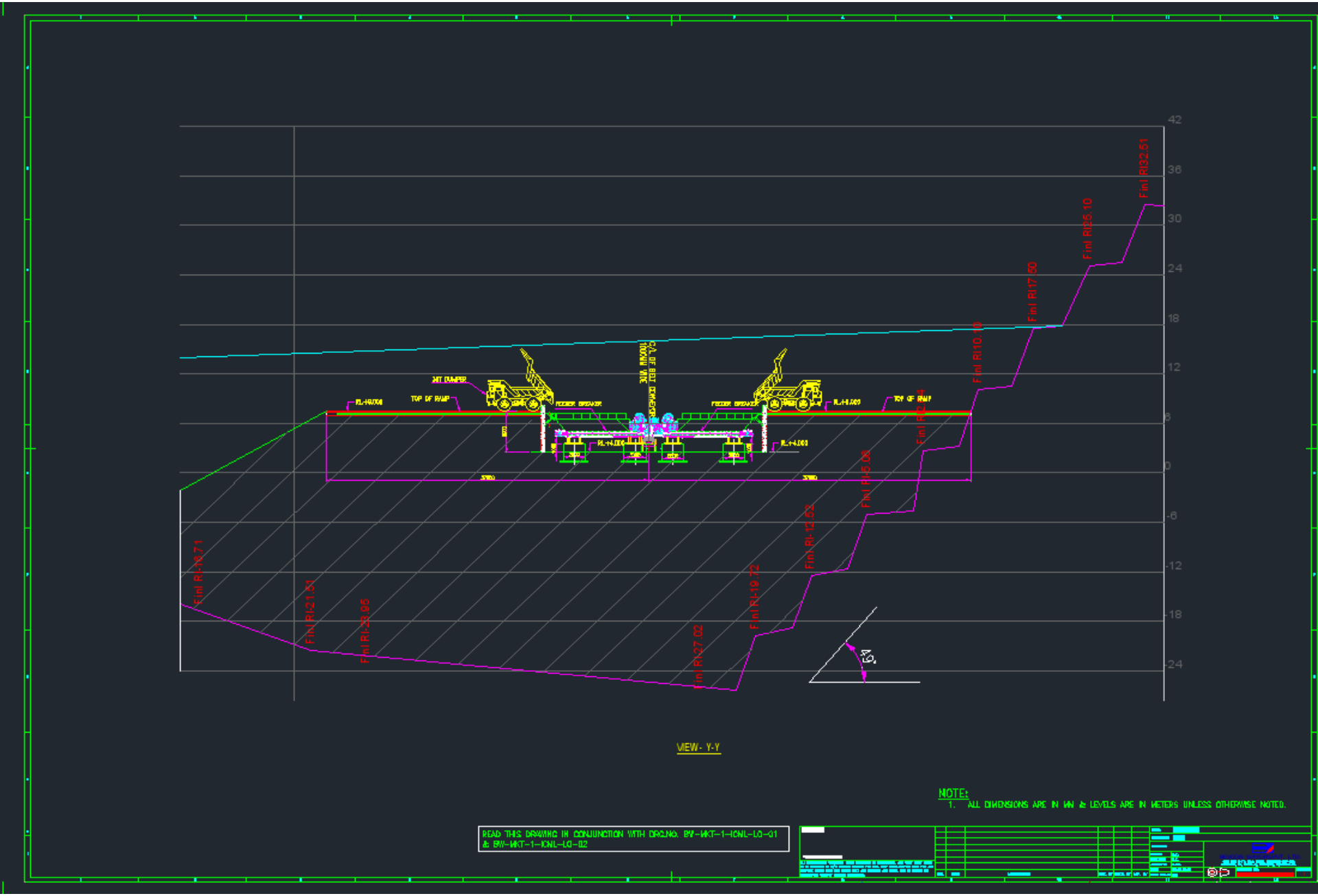
LAYOUT OF IN-PIT CRUSHING & DSI SNAKE IN 'OB' HIGHWALL ON CTUAL MINE PLAN



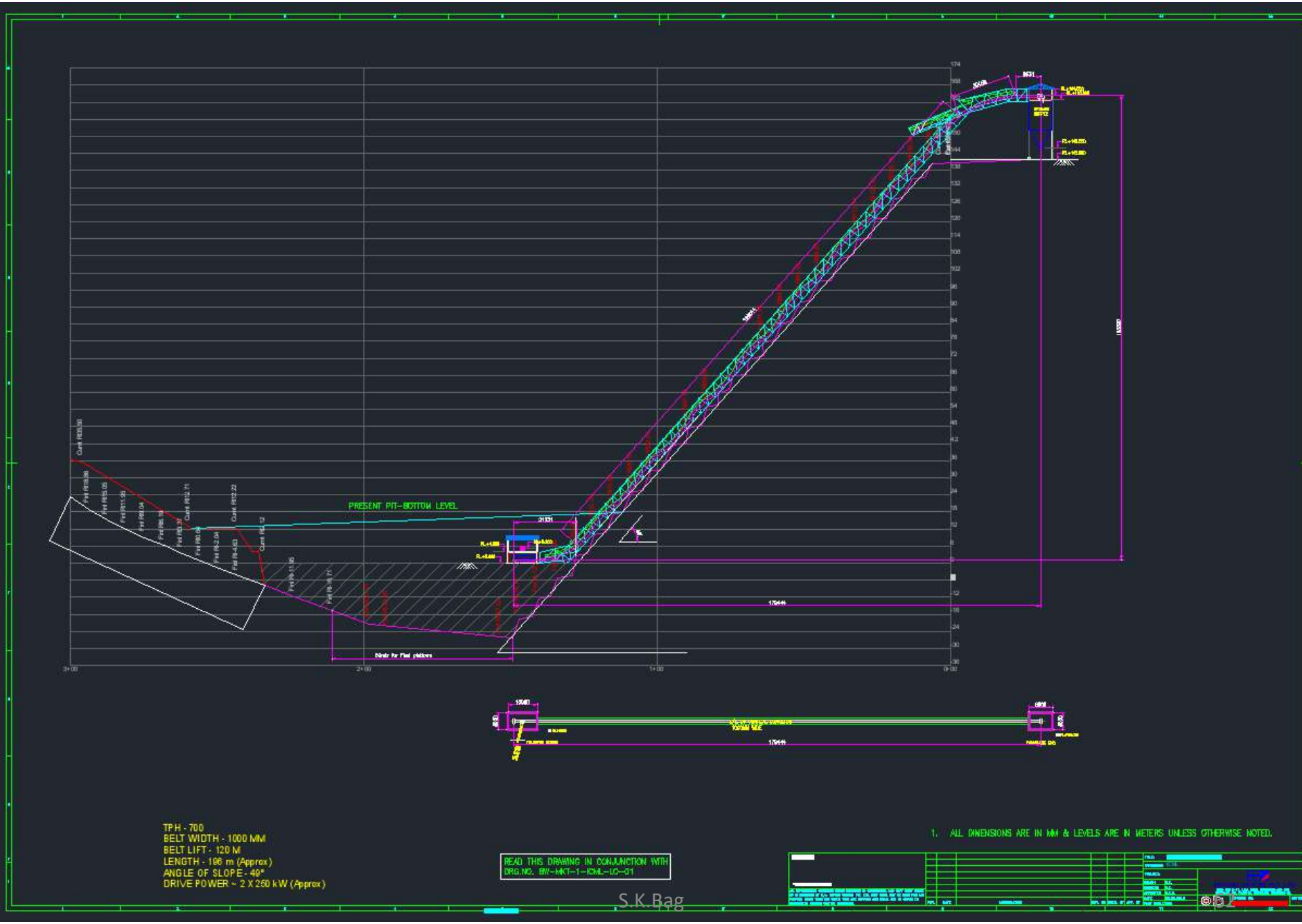
TRUCK UNLOADING & CRUSHING OF COAL AT PIT BOTTOM & LOADING ONTO BENCH CONVEYOR FOR FEEDING ONTO DSI CONVEYOR



TRUCK UNLOADING & CRUSHING OF COAL AT PIT BOTTOM



LAYOUT OF DSI SNAKE HIGH ANGLE CONVEYOR ON ‘OB’ HIGHWALL



CALCULATION OF OWNING & OPERATING COST FOR DSI CONVEYOR & IN-PIT CRUSHING

DATA TABLE	ALTERNATIVE I (INVESTMENT MADE IN '0' YEAR		HAC + Feeder Breaker + Bench Conveyor & others		Dumper cost (Rs)				
Total production (Million Te)	3.0	Annual operating hours	1400 mm HAC (200 m profile length)		Total dumper cost calculated with av. round trip distance of 1.5 km @ Rs 12.00 per te per km	HAC + Feeder Breaker + Bench Conveyor & others		M INR /a	Rs / te
700.0	t/hr	4,250.0			18.0			10.0%	
No.of lines..units >			1		OPERATING LIFE OF PROJECT [YEARS] >			9	
INVESTMENT		M INR	360.00			360.0		360.0	
YEARLY CAPITAL COST		M INR/a	62.51			62.51		62.51	21.01
Length m ... S. Weight t									
ex factory		1000 INR							
erection		1000 INR							
transport									
Elec. Unit cost (Rs)	6.00								
ENERGY COST		M INR/a	19.508			19.508	0.000	19.508	6.557
Installed Power		kW	900						
av.Load factor			85%						
ex factory		kW	765						
SPARES COST		M INR/a	10.000			10.000	0.000	10.000	3.361
Spares / 1000h		%of Inv							
		M INR/a				0.00	0.00	0.00	0.00
Wearparts/1000h		%of Inv							
		M INR/a				0.00	0.00	0.00	0.00
AMC COST		M INR/a	36.000			36.000	0.000	36.000	12.101
Percentage of capital cost			10.00%						
Oper.Labor		M INR/a							
Repair.Labor		Group							
Group		Hrs/a							
Repair.Labor		M INR/a							
IPC & HAC Operating Cost		MINR / a>	65.51		OPERATING COST FOR HAC & IPC (Rs/Te)				22.02
Dumper transportation cost for System I Rs/Te					18.00	Dumper cost (Rs/Te)			18.00
IPC, Conveyor & Dumper shuttle in-pit		Alternative I			Total for IPC, Conveyor & Dumper shuttle (Rs/Te) >				40.02

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OPERATING COST FOR IN-PIT CRUSHING & DSI CONVEYOR (ALT – I)

ALT I

IPC, HAC and Dumper shuttle Cost

Rs/ te

AMC Cost	12.10				12.10	30.2%
Energy		6.56			6.56	16.4%
Spare Parts			3.36		3.36	8.4%
Dumper cost				18.00	18.00	45.0%
TOTAL COST	12.10	6.56	3.36	18.00	40.02	100.0%

COMPARISON OF COST FOR BOTH DSI SNAKE (ALT – I) & TRUCK TRANSPORT (ALT II)

DATA TABLE	ALTERNATIVE II DUMPER SHUTTLE TO SURFACE					
ANNUAL PRODUCTION	3.0	Million Te/Annum				
700	t/hr	4,250	EFEECTIVE ANNUAL HOURS			
	DUMPER COST/TE/KM (INR)	IPC & HAC COST (INR)	AV. DUMPER ROUND TRIP DISTANCE (KM)	DUMPER COST (INR)	CRUSHING COST (INR)	TOTAL COST (INR)
Alt - II	12.00	0.00	6.30	75.60	10.00	85.60
Alt - I	12.00	22.02	1.50	18.00	0.00	40.02

NOTE: ONE WAY DUMPER LEAD DISTANCE SHALL VARY AS FOLLOWS:
ALT - I - 0.5 KM TO 1 KM
ALT II - 2.8 KM TO 3.5 KM

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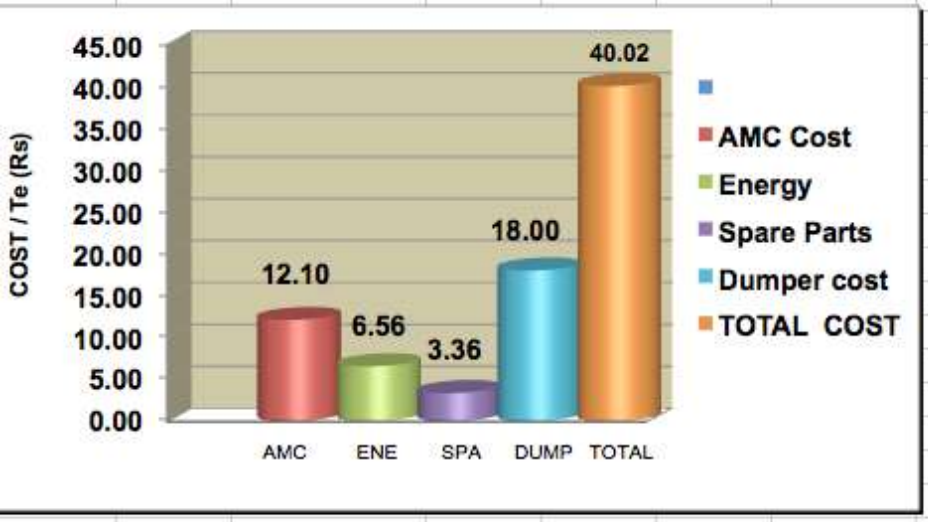
GRAPHICAL COMPARISON OF OP. COST BETWEEN DSI SNAKE (ALT – I) & TRUCK TRANSPORT (ALT II)

OPEN - PIT MINE OPTIMISATION PROGRAM

Specific Cost / te (Rs) 3.0 Mt/a

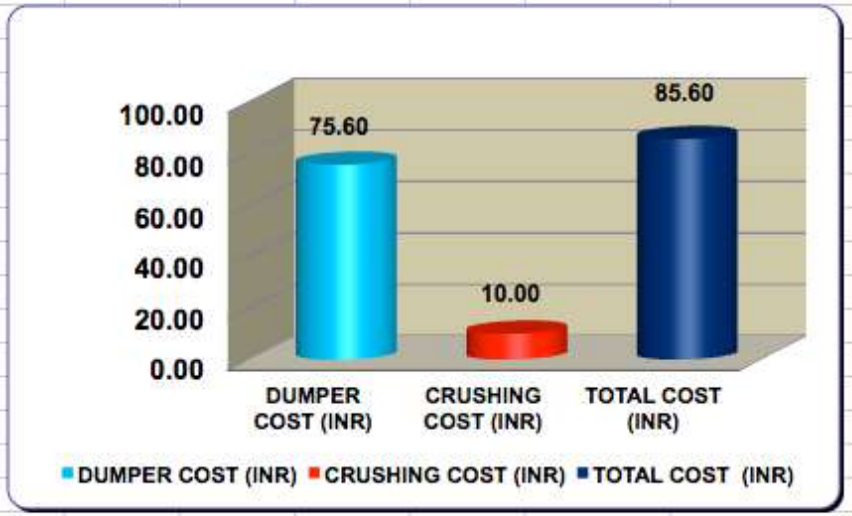
ALTERNATIVE I **40.02** **Rs/te**

IPC, HAC & DUMPER SHUTTLE



ALTERNATIVE II **85.60** **Rs/te**

DUMPER TRANSPORT UPTO SURFACE YARD & CRUSHING



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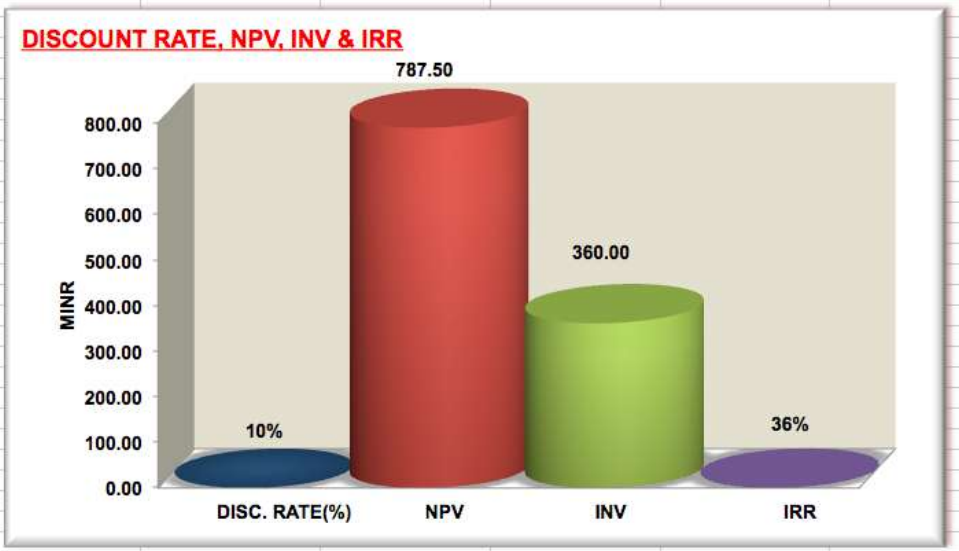
IRR CALCULTION FOR DSI SNAKE CONVEYOR SYSTEM

IRR & NPV CALCULATION (INVESTMENT MADE IN '0' YEAR)

		ALTERNATIVE I (IPC & HAC)			ALTERNATIVE - II (DUMPER SHUTTLE TO SURFACE)			DIFFERENCE	NET SAVINGS	ANNUAL PRODUCTION (MTPA)	DISCOUNT RATE FOR NPV
YEAR	CAPITAL INVESTMENT (MINR) FOR ALT-I	OPERATING COST/TE (INR)	DUMPER COST/TE (INR)	TOTAL COST FOR ALTERNATIVE I	DUMPER COST/TE (INR)	CRUSHING COST/TE (INR)	TOTAL COST FOR ALTERNATIVE II	COST/TE (INR)	MINR	3.00	10%
0 year	-360.00										
1st	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
2nd	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
3rd	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
4th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
5th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
6th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
7th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
8th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
9th	136.74	22.02	18.00	40.02	75.60	10.00	85.60	45.58	136.74		
NPV	787.50										
IRR	36%										

NOTE: A NOMINAL CRUSHING COST OF RS 10.00 HAS BEEN ASSUMED IN CALCULATION. ACTUAL CRUSHING COST IS LIKELY TO BE MORE. INCREASE IN CRUSHING COST SHALL FURTHER IMPROVE IRR.

DISCOUNT RATE	10%
NPV	787.50
CAPITAL INVESTMENT	360.00
IRR	36%



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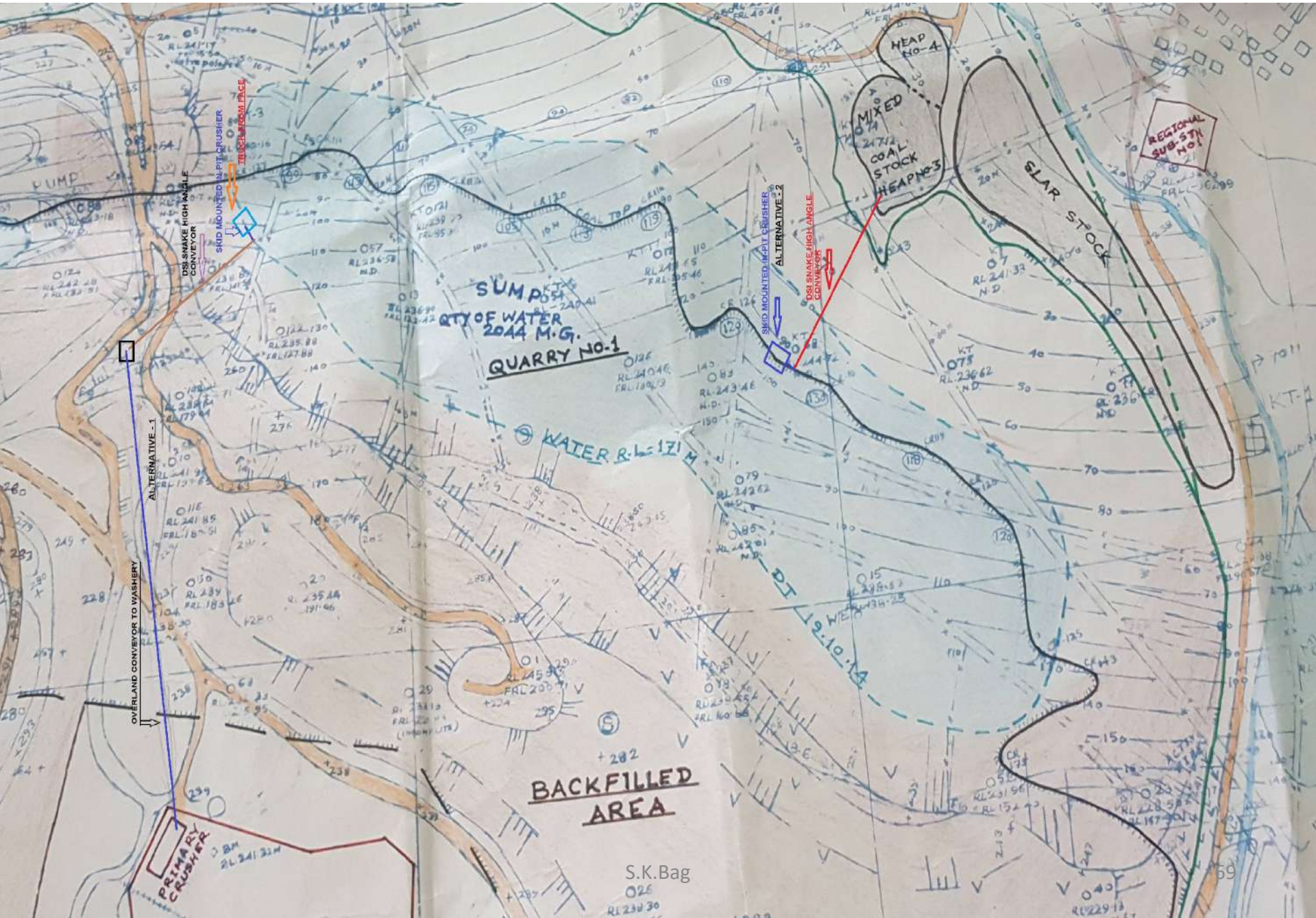
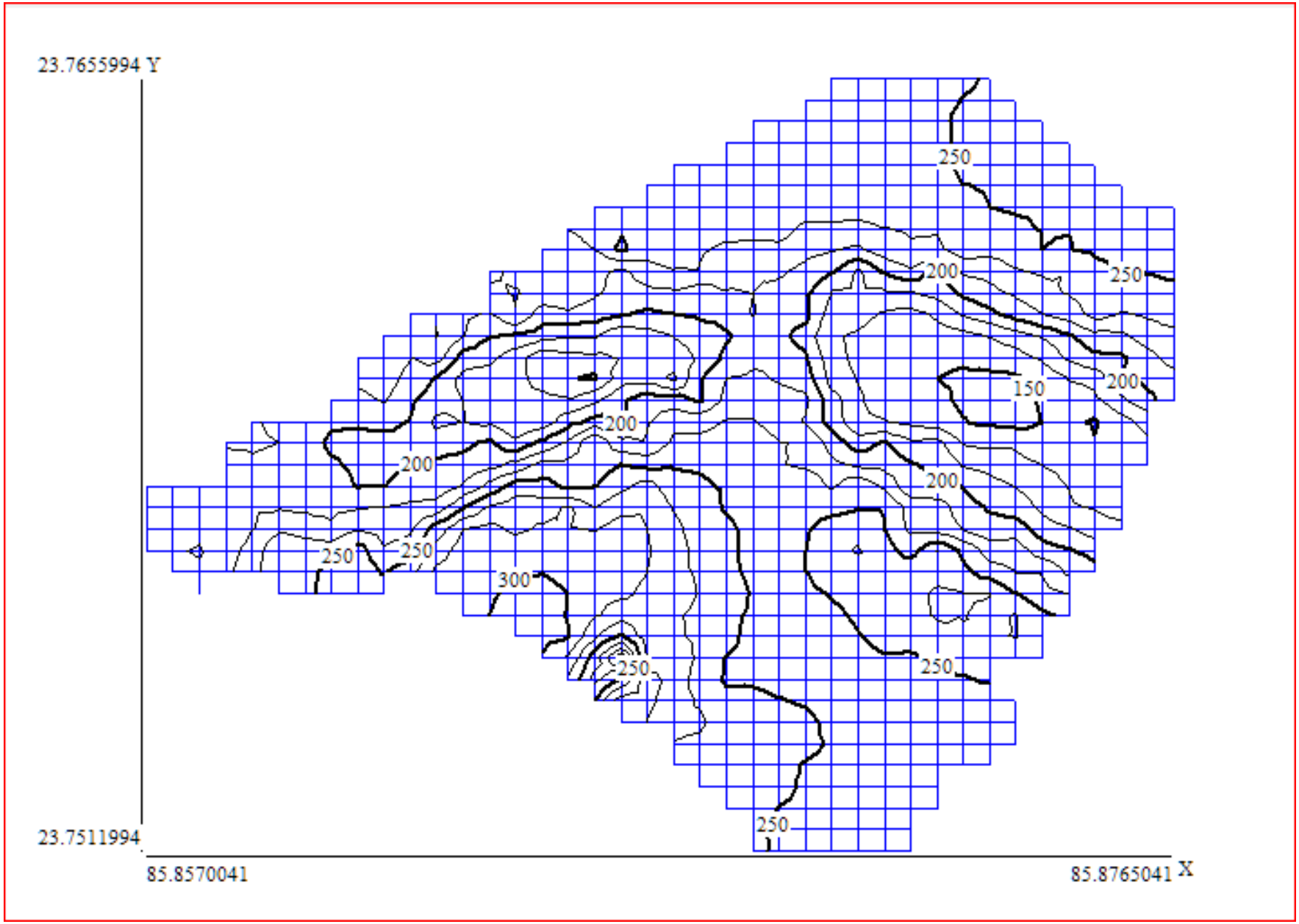
CASE STUDY FOR KATHARA PROJECT AS REQUESTED BY DIRECTOR (TECHNICAL), CCL

SURVEYED PLAN OF EASTERN SECTOR OF KATHARA MINE



AERIL VIEW OF HAC FROM BOTH EASTERN SECTOR & CENTRAL SECTOR PITS & OVERLAND CONVEYOR TO WASHERY

CONTOUR DRAWN BASED ON GOOGLE EARTH



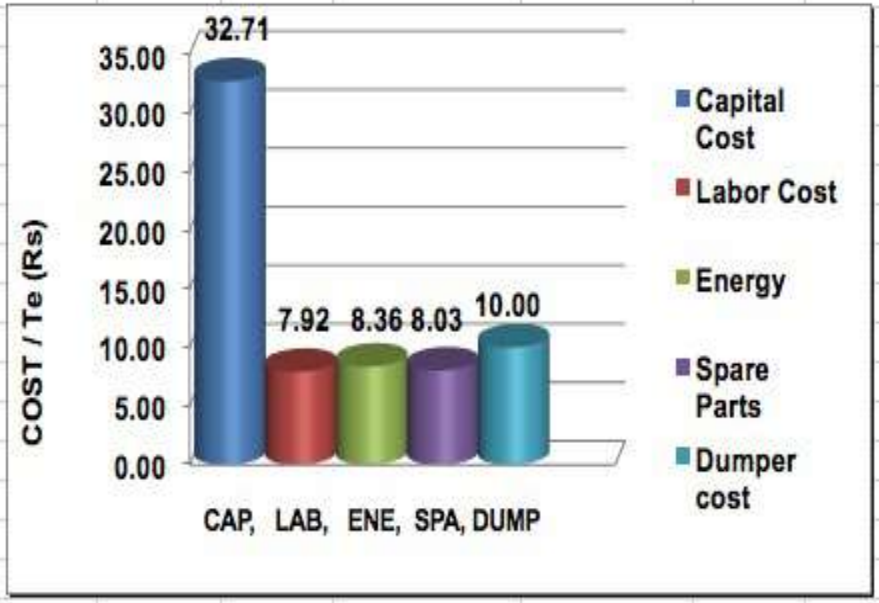
OPEN - PIT MINE OPTIMISATION PROGRAM

ANNEXURE 4

Specific Cost / te (Rs) 1.0 Mt/a

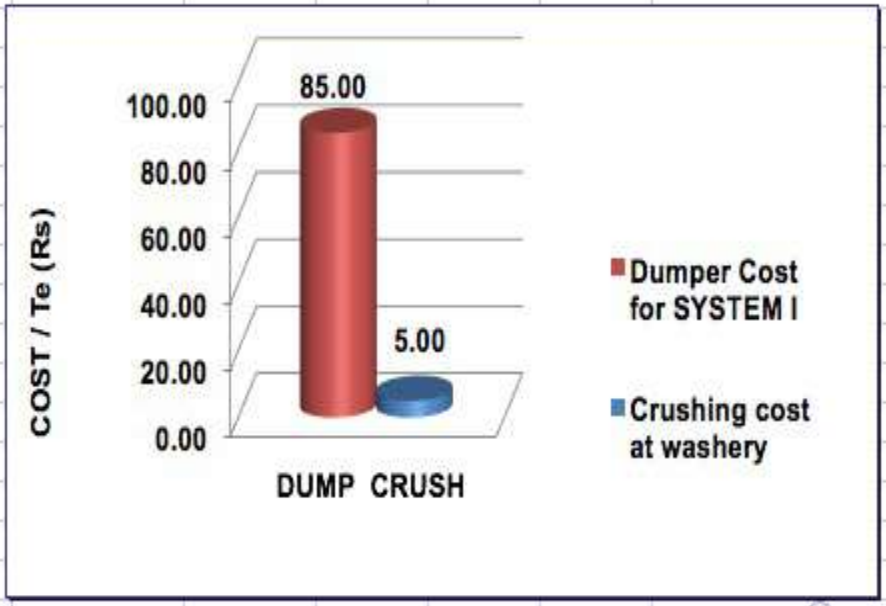
SYSTEM-II 67.03 Rs/te

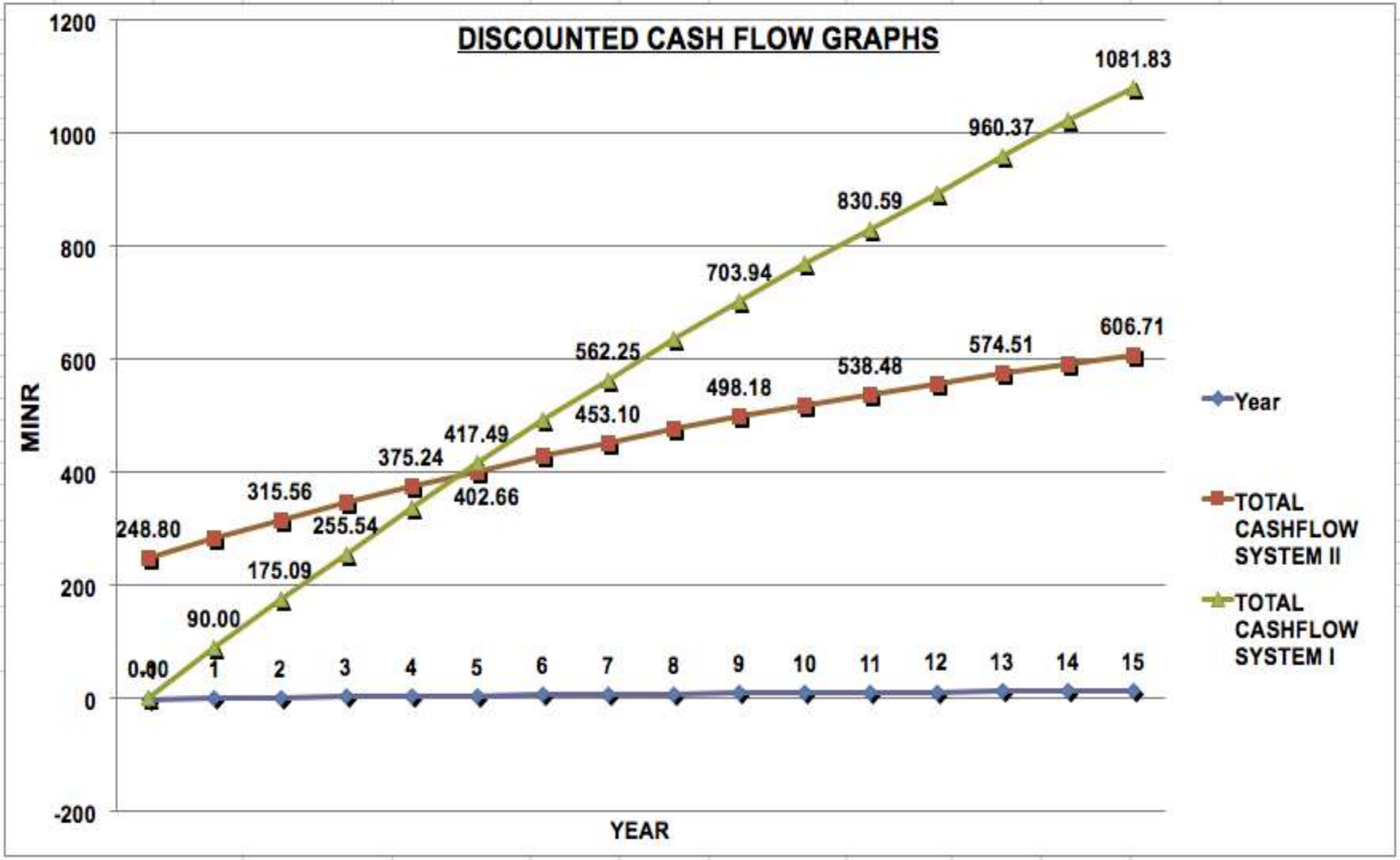
IPC, HAC, OLC & DUMPER SHUTTLE IN-PIT



SYSTEM - I 90.00 Rs/te

DUMPER TO WASHERY & CRUSHING AT WASHERY




DISCOUNTED CASH FLOW GRAPHS
MINR
YEAR
1200
1000
800
600
400
200
0
-200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
248.80
315.56
375.24
402.66
453.10
498.18
538.48
574.51
606.71
0.00
90.00
175.09
255.54
417.49
562.25
703.94
830.59
960.37
1081.83
Year
TOTAL CASHFLOW SYSTEM II
TOTAL CASHFLOW SYSTEM I

NPV, IRR & PAY BACK PERIOD FOR SYSTEM II

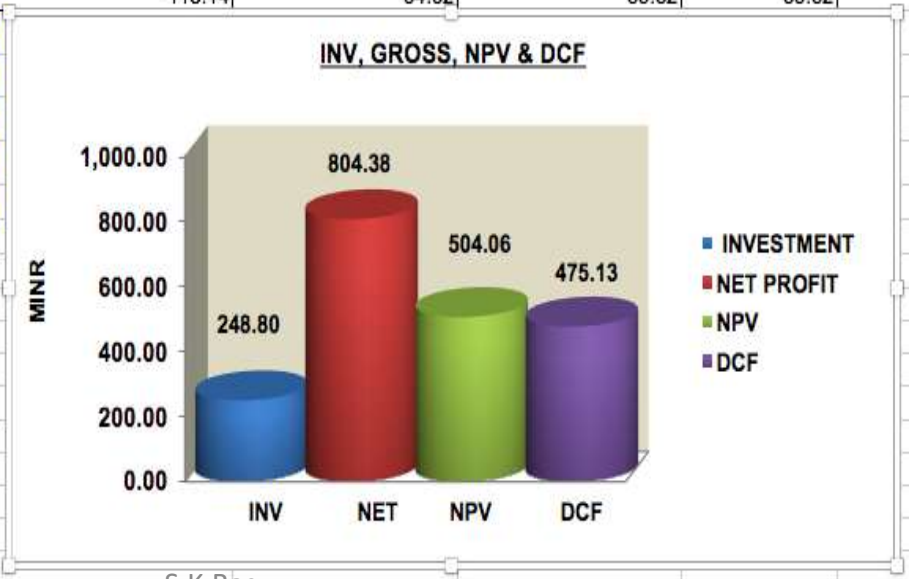
ANNEXURE 7

		SYSTEM - I	SYSTEM - II	SAVINGS IN COST FOR SYSTEM II	ANNUAL NET SAVINGS	ANNUAL PRODUCTION (MTPA)	DISCOUNT RATE FOR NPV
YEAR	CAPITAL INVESTMENT (MINR) FOR SYSTEM - II	OPERATING COST (Rs/Te)	OPERATING COST (Rs/Te)	COST/TE (INR)	MINR	1.00	10%
0 year	-248.80						
1st	55.68	90.00	34.32	55.68	55.68		
2nd	55.68	90.00	34.32	55.68	55.68		
3rd	55.68	90.00	34.32	55.68	55.68		
4th	64.18	98.50	34.32	64.18	64.18		
5th	64.18	98.50	34.32	64.18	64.18		
6th	64.18	98.50	34.32	64.18	64.18		
7th	64.18	98.50	34.32	64.18	64.18		
8th	73.53	107.85	34.32	73.53	73.53		
9th	73.53	107.85	34.32	73.53	73.53		
10th	73.53	107.85	34.32	73.53	73.53		
11th	73.53	107.85	34.32	73.53	73.53		
12th	83.82	118.14	34.32	83.82	83.82		
13th	83.82	118.14	34.32	83.82	83.82		
14th	83.82	118.14	34.32	83.82	83.82		
15th	83.82	118.14	34.32	83.82	83.82		

NET PROFIT (MINR)	804.38
NPV (MINR) @ 10%	504.06
IRR	24%
PAY BACK PERIOD (YRS)	4.47
DCF (MINR)	475.13

SYSTEM II	MINR
INVESTMENT	248.80
NET PROFIT	804.38
NPV	504.06
DCF	475.13

NOTE: DCF has been calculated considering NPV @ 10%
& escalation @ 4% per year



S.K.BAG

ANNEXURE 8

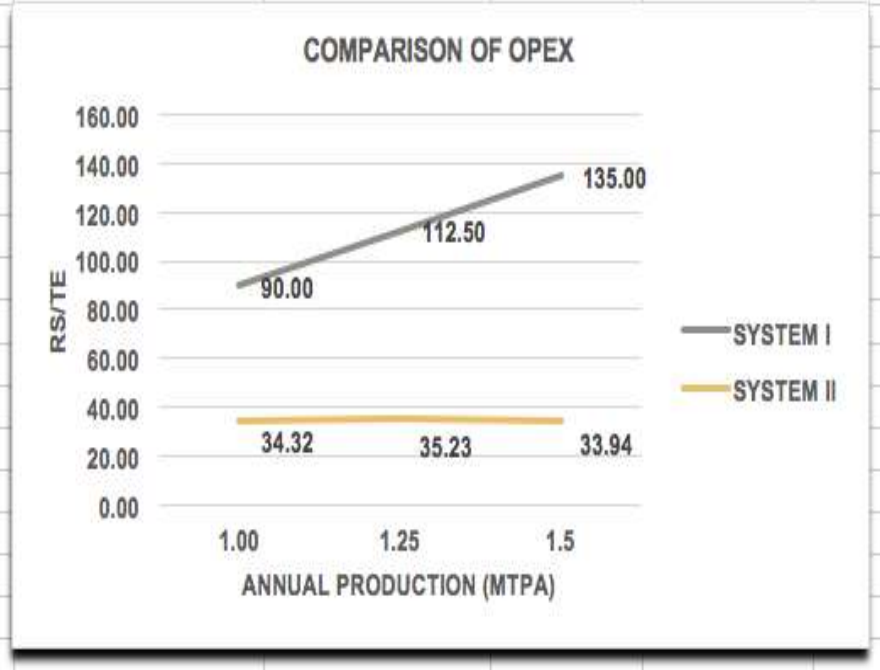
COMPARATIVE FINANCIAL ANALYSIS FOR VARIOUS OPTIONS FOR DSI SNAKE HAC

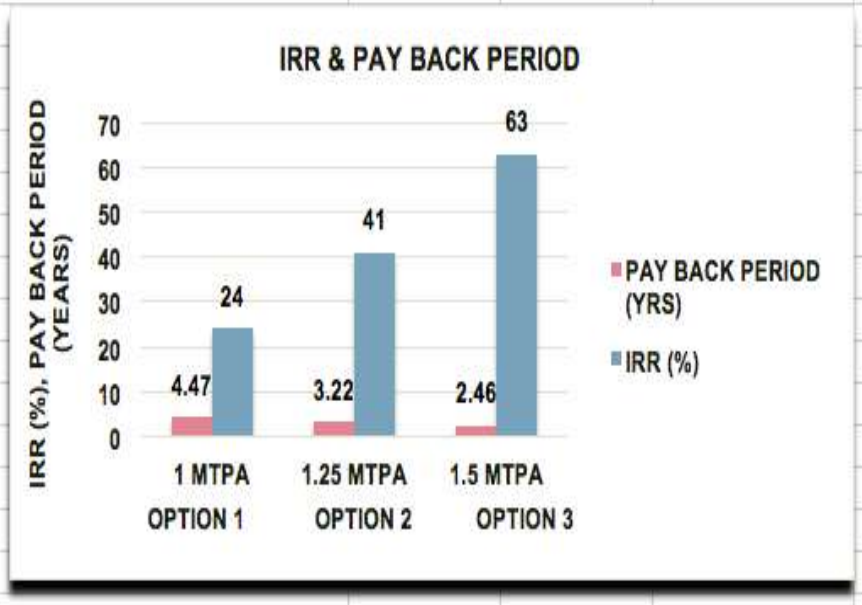
	OPTION 1	OPTION 2	OPTION 3
CAPITAL INVESTMENT (MINR)	248.80	248.80	248.80
PRODUCTION (MTPA)	1.00	1.25	1.5
NET PROFIT (MINR)	804.38	1540.48	2515.31
NPV (MINR)	504.06	860.46	1334.16
DCF (MINR)	475.13	736.03	1019.93
IRR (%)	24	41	63
PAY BACK PERIOD (YRS)	4.47	3.22	2.46
	1 MTPA	1.25 MTPA	1.5 MTPA
PAY BACK PERIOD (YRS)	4.47	3.22	2.46
IRR (%)	24	41	63

NOTE: DCF has been calculated considering NPV & escalation @ 4% per year

COMPARATIVE STATEMENT OF OPEX FOR SYSTEM I & II (RS/TE)

	PRODUCTION (MTPA)	SYSTEM I	SYSTEM II
OPTION 1	1.00	90.00	34.32
OPTION 2	1.25	112.50	35.23
OPTION 3	1.5	135.00	33.94





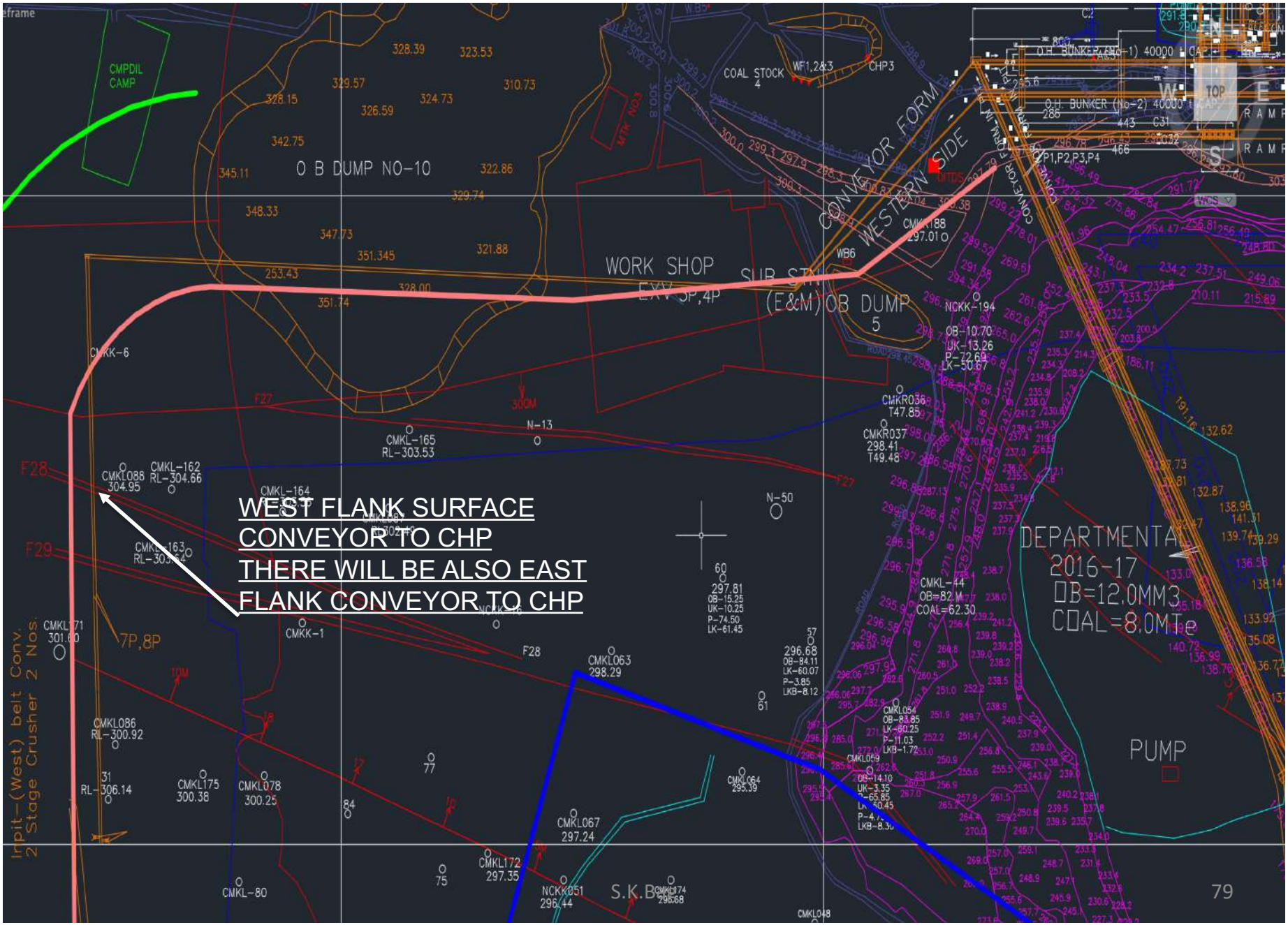
Google earth and mine transport system for Kathara

https://youtu.be/rYtnlB8Ggj8

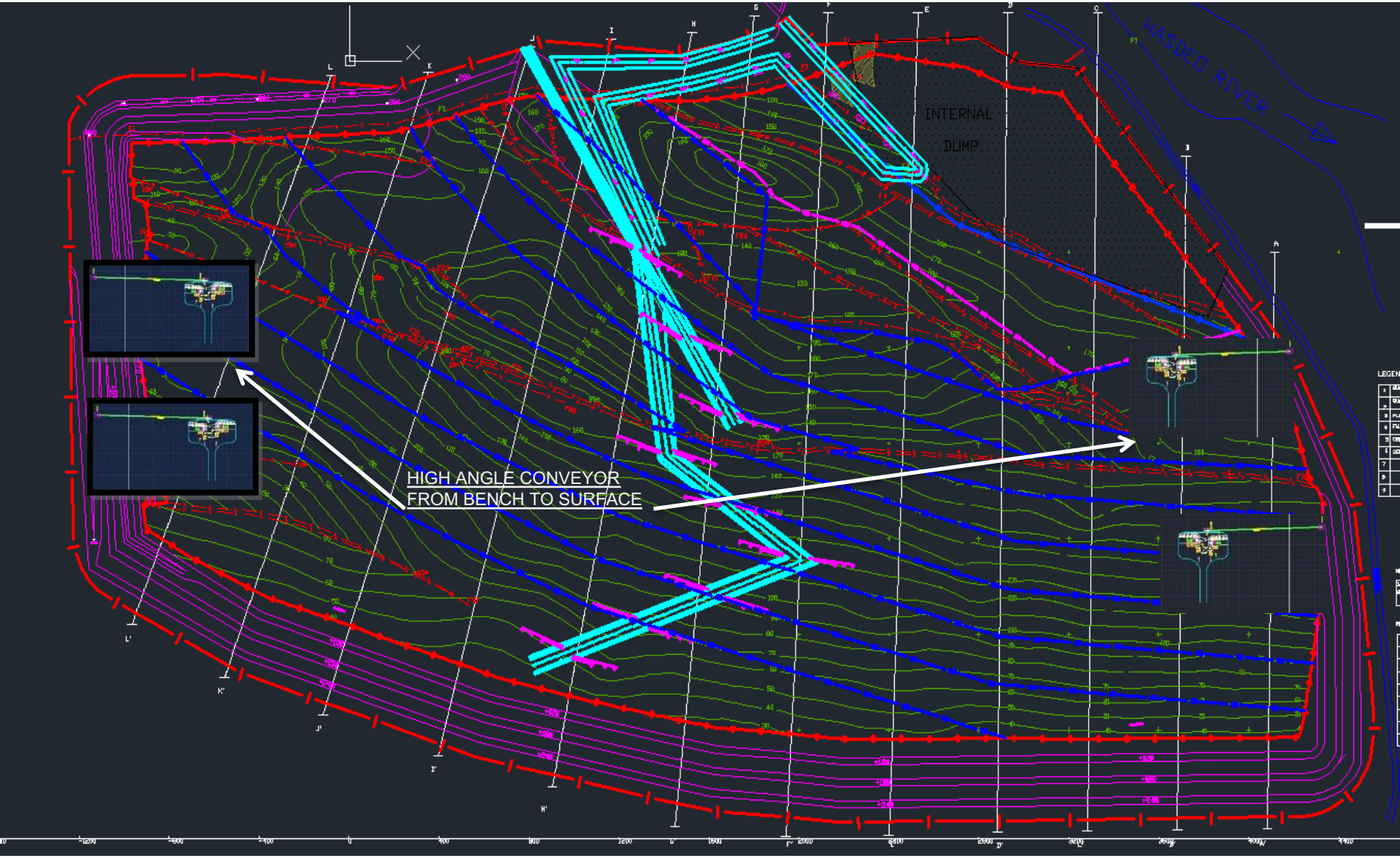
CASE STUDY FOR KUSMUNDA OPENCAST PROJECT AS REQUESTED BY PROJECT

PRESENT DUMPER TRANSPORT AT KUSMUNDA OPENCAS

CMPDI PROPOSAL - WEST SIDE AND EAST SIDE FLANK OLC TO CHP

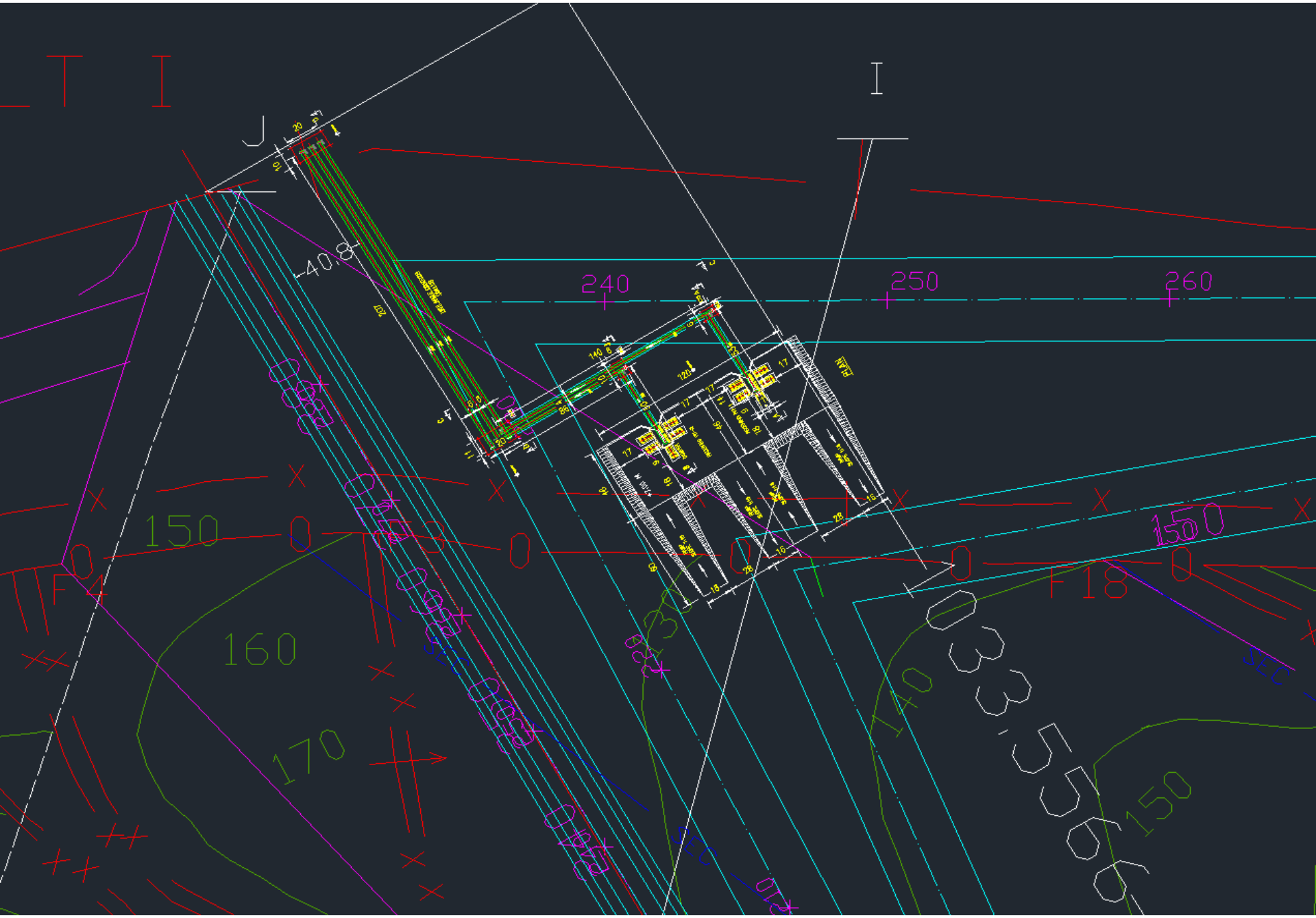


PROPOSAL FOR TRANSPORTING COAL BY DSI SNAKE HAC FROM TOP & MIDDLE COAL SEAMS FROM BENCHES TO FLANK CONVEYORS

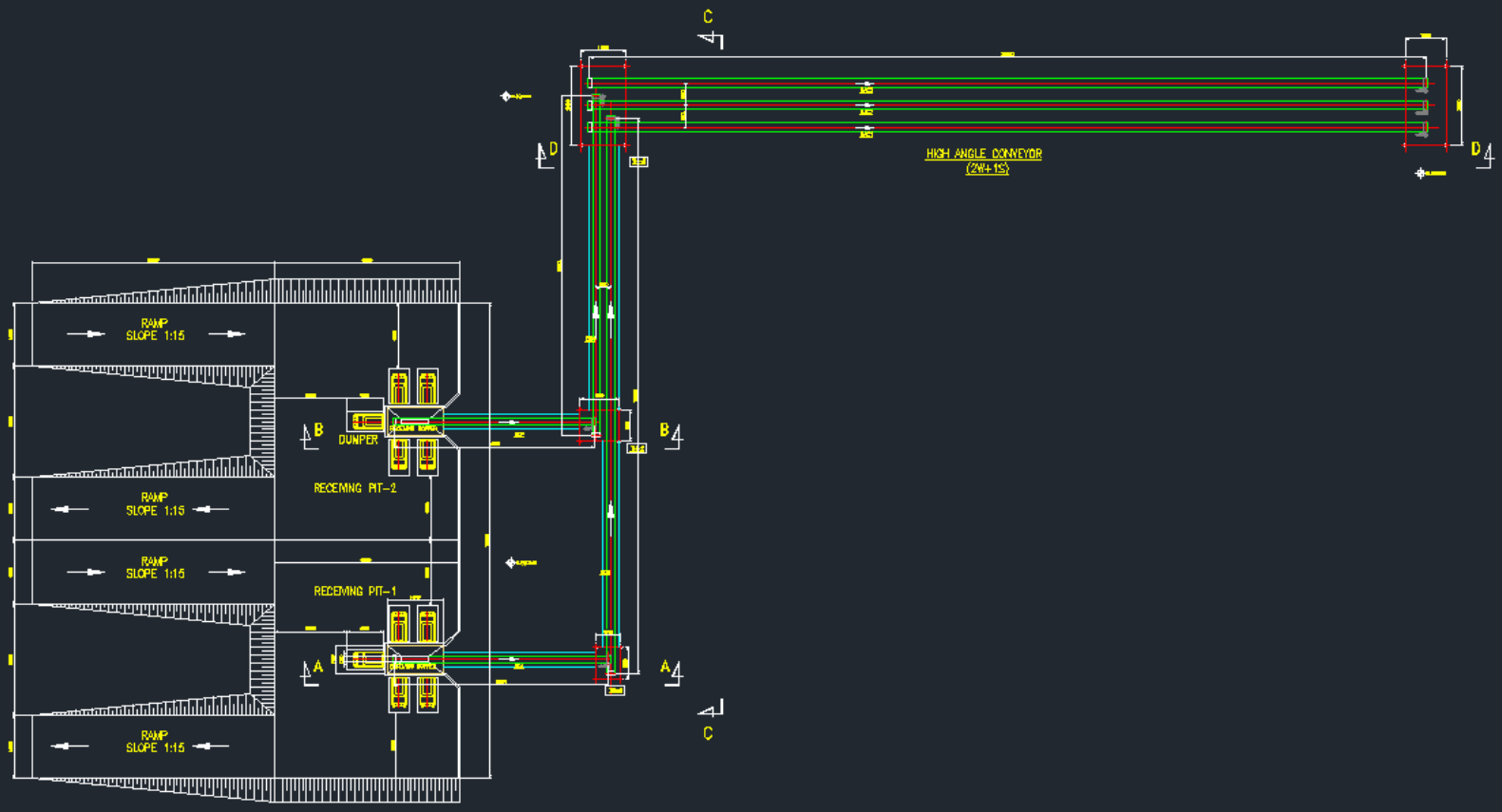


FINAL STAGE OF QUARRY PLAN

INTEGRATED SCHEME OF COAL TRANSPORT FROM KUSMUNDA BOTTOM SEAM



DUMPER UNLOADING ARRANGEMENT THROUGH RECEIVING PIT AT PIT BOTTOM

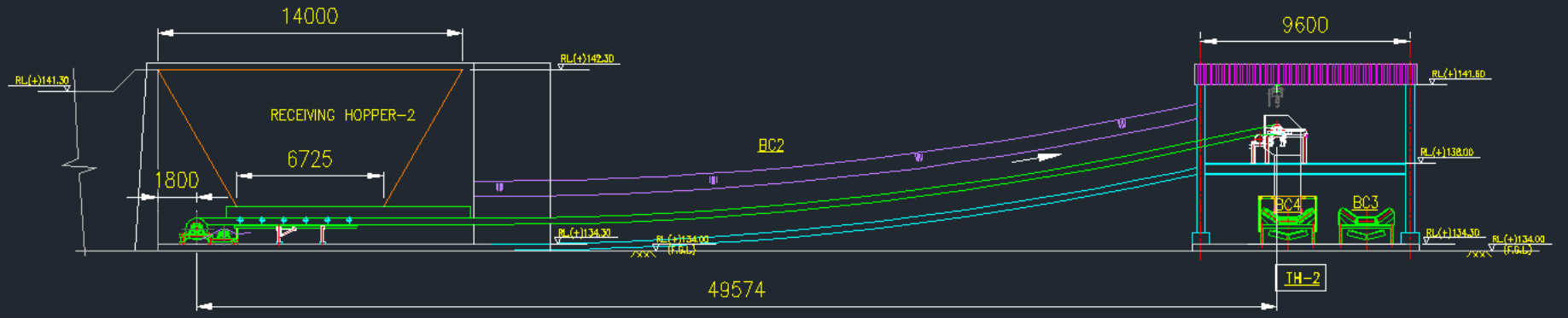


PLAN

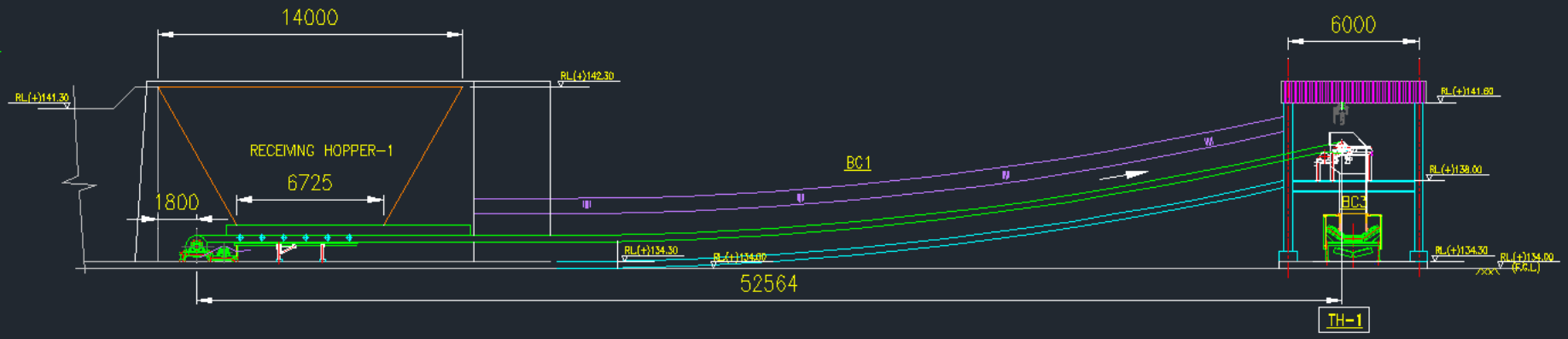
NOTE:-

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS IS AN INTEGRATED SCHEMTEC ARRANGEMENT SHOWING DUMPER UNLOADING DSI SNAKE HIGH ANGLE CONVEYOR SYSTEM FOR TRANSPORT OF COAL FROM KUSMUNDA BOTTOM SEAM TO SURFACE.
3. THREE NOS. WITH 2 WORKING & 1 STANDBY DSI SNAKE HAC OF 4000TPH CAPACITY (EACH) HAS BEEN PROPOSED.
4. EACH DUMPER RECEIVING HOPPER SHALL BE ABLE TO RECEIVE COAL FROM 5 NOS. 60 T DUMPER SIMULTANEOUSLY.
5. RECEIVING HOPPER SHALL BE SKID MOUTED & SHIFTABLE.
6. ALL THE DSI SNAKE HAC CAN BE DISMANTED & SHIFTED WITHIN PIT AS AND WHEN REQUIRED.
7. ALL DIMENSIONS ARE INDICATIVE.

BELT FEEDER BELOW RECEIVING PIT



VIEW B-B



VIEW A-A

NOTE:-

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS IS AN INTEGRATED SCHEMITEC ARRANGEMENT SHOWING DUMPER UNLOADING DSI SNAKE HIGH ANGLE CONVEYOR SYSTEM FOR TRANSPORT OF COAL FROM KUSMUNDA BOTTOM SEAM TO SURFACE.
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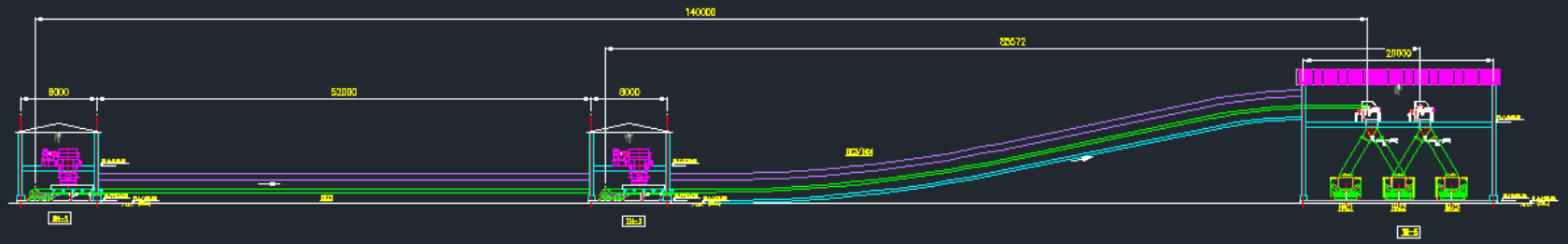
5. RECEIVING HOPPER SHALL BE SKID MOUTED & SHIFTABLE.
6. ALL THE DSI SNAKE HAC CAN BE DISMANTED & SHIFTED WITHIN PIT AS AND WHEN REQUIRED.
7. ALL DIMENSIONS ARE INDICATIVE.

READ THIS DRAWING IN CONJUNCTION WITH DRG.NO. BW-MKT-1-SECL-LO-01

BENCH CONVEYOR LOADING THREE DSI SNAKE HIGH ANGLE CONVEYORS



VIEW C-C

NOTE:-

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS UNLESS OTHERWISE NOTED.
2. THIS IS AN INTEGRATED SCHEMITEC ARRANGEMENT SHOWING DUMPER UNLOADING DSI SNAKE HIGH ANGLE CONVEYOR SYSTEM FOR TRANSPORT OF COAL FROM KUSMUNDA BOTTOM SEAM TO SURFACE.
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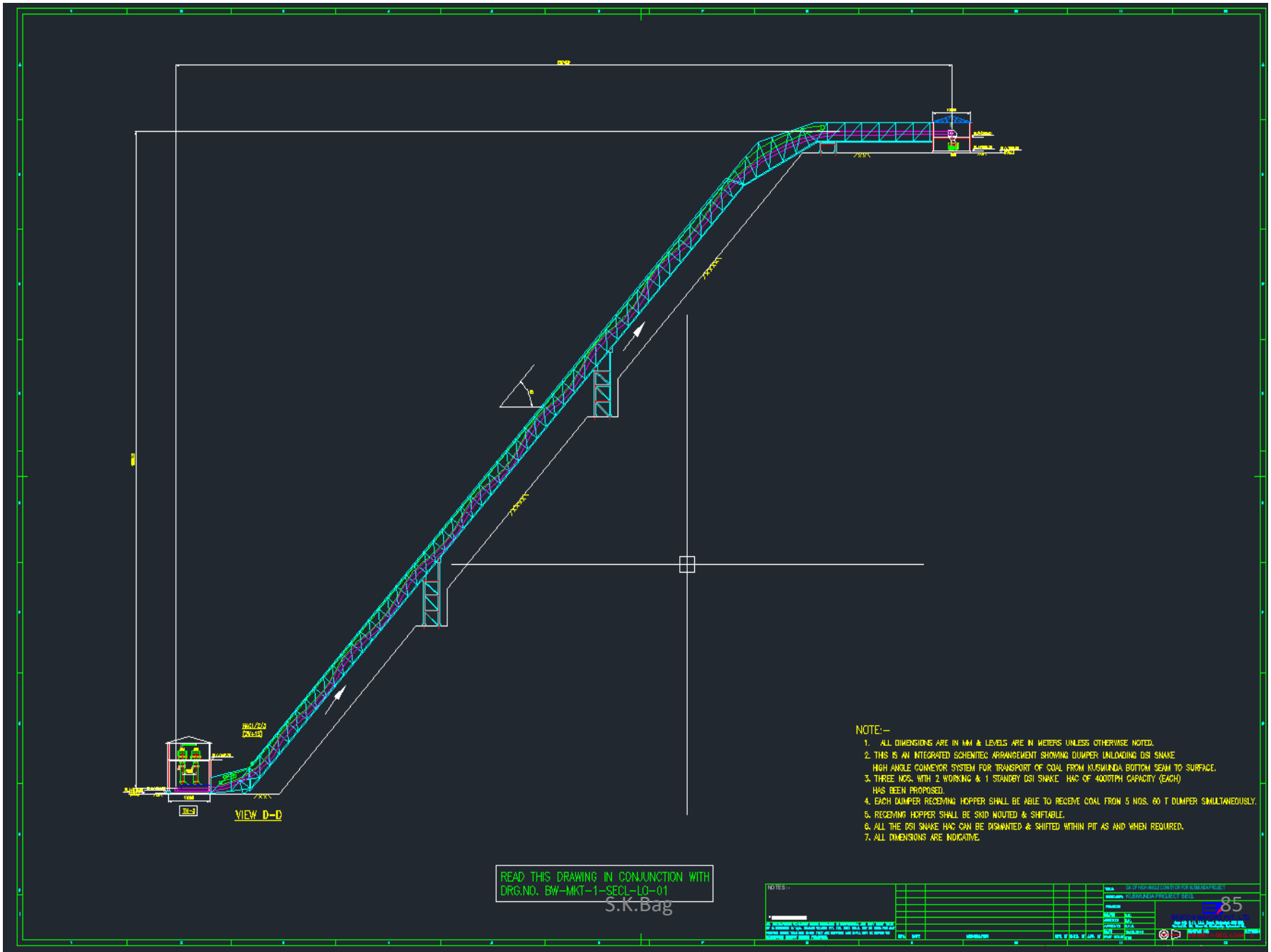
7. ALL DIMENSIONS ARE INDICATIVE.

READ THIS DRAWING IN CONJUNCTION WITH DRG.NO. BW-MKT-1-SECL-LO-01

PROPOSED DSI HIGH ANGLE CONVEYOR FROM PIT BOTTOM TO SURFACE



A CASE STUDY ON COMPARISON BETWEEN ALL TRUCK SYSTEM & CONVEYOR WITH HIGH ANGLE CONVEYOR SYSTEM

High Angle Conveyor Offers Mine Haulage Savings

Authors:

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Manager - Systems
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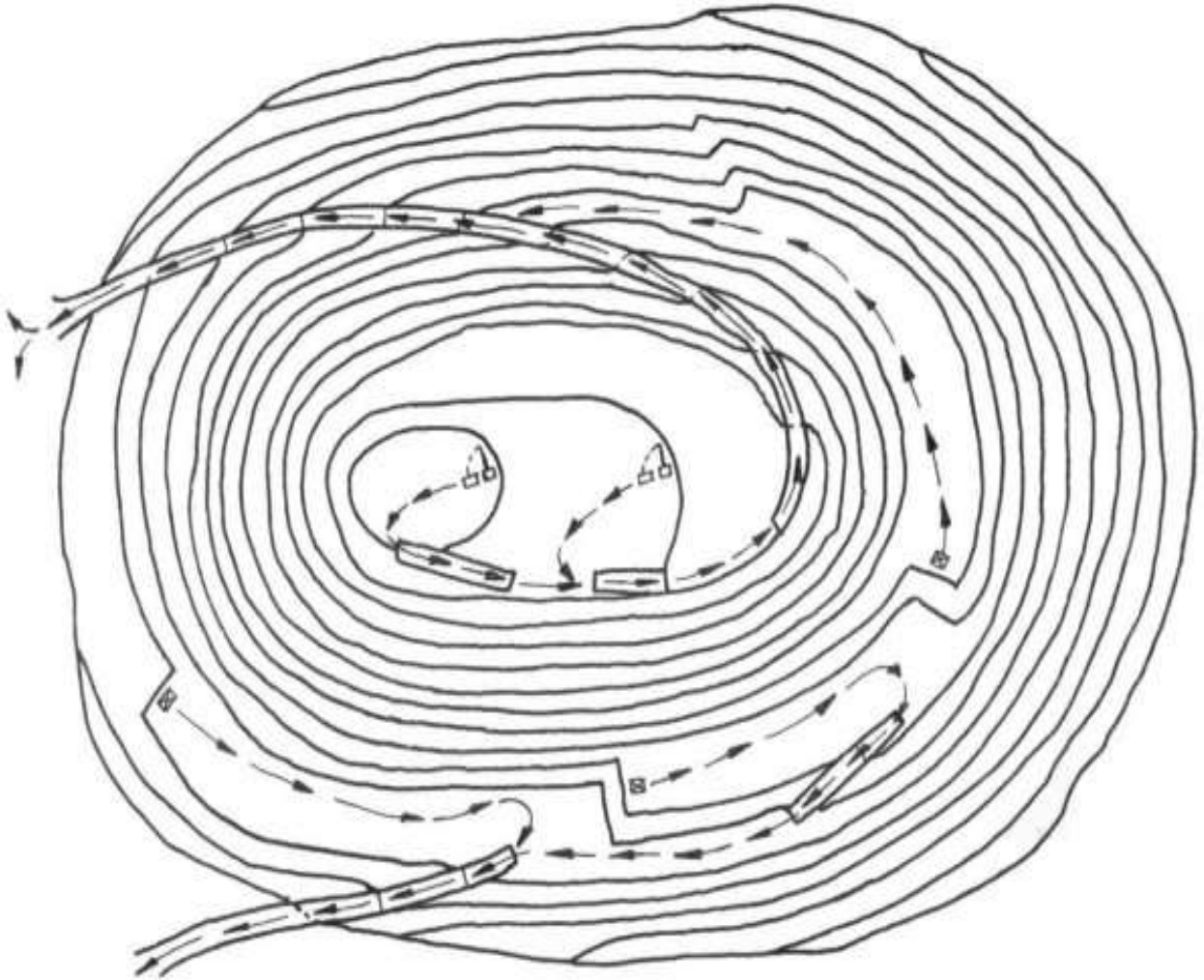
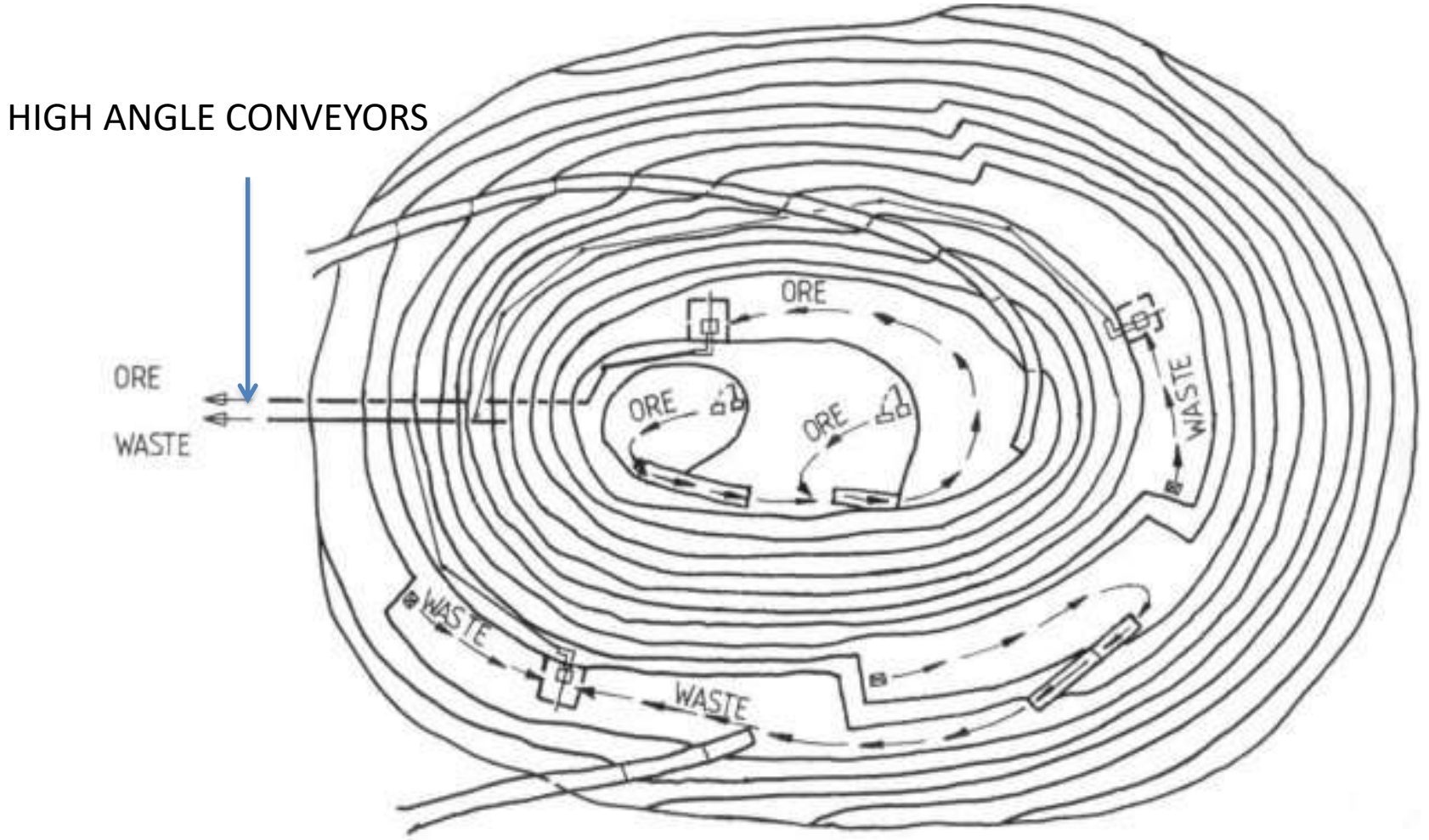
Winfield, Alabama, U.S.A.
D.W. Albertson
General Manager/Director
Spencer (Melksham) S.A. (Pty) Ltd.
Johannesburg,
South Africa

FIG - 1



PIT SHOWING TRUCK HAULAGE SYSTEM

FIG - 2



SAME PIT SHOWING IN-PIT CRUSHER - CONVEYOR HAULAGE SYSTEM

COMPARISON OF CAPITAL COST BETWEEN CONVEYOR, HIGH ANGLE CONVEYOR AND DUMPER

TYPICAL ARRANGEMENT OF MODULAR
HIGH ANGLE CONVEYORS
Spencer(Melksham) S.A. (Pty)Ltd.
ADDENDUM
COMPARATIVE COSTS OF CONVENTIONAL
VERSUS
HIGH ANGLE CONVEYING
IN A SOUTH AFRICAN OPEN PIT MINE

Introduction

This is a summary of a study which evaluates the difference in Initial and Maintenance costs (over a 15 year period) of two alternative systems for conveying material out of an open pit mine. It compares only the conveyors needed to lift material from pit bottom to it's lip.

SYSTEM 1

CONVENTIONAL conveyors, each of capacity 5 000 tph, Single flight length, 1 000 metres, lift 80 metres. 3 flights with total length of 3 000 metres for overall lift of 240 metres. Angle of lift 4,3 degrees.

SYSTEM 2

HIGH ANGLE conveyor, capacity 5 000 tph, Single flight length 391 metres, lift 240 metres, Angle of lift 53 degrees.

The conclusion reached is that the High Angle Conveyor is the most economical alternative. The cost per tonne of ore transported is 4 cents versus 6 cents for conventional conveyors. Truck haulage could, by comparison, cost 41 cents per tonne or more.

COMPARISON OF CAPITAL COST BETWEEN CONVEYOR AND HIGH ANGLE CONVEYOR OVER 15 YEARS

A. CAPITAL COSTS

Capital costs were established by estimating each system in detail to an accuracy of +-10%
These costs are summarised on Table A.
The High Angle Conveyor does not require a seperate drive house as the drives are positioned in the head end structure.

	Capacity TPH	No. of flights	Total Lift	Total kW Inst.	Full Load kW	50% Load kW	No. Load kW	Head sect. Cost	Lin.M. Costs	Tail & TU Sect Cost	Drive Hse Costs	Total Installed Cost
								R000s	R000s	R000s	R000s	R000s
Conventional Conveyors												
3 off each	5000	3	240m	6030	4797	2745	399	4825	5898	578	928	12229
1000m long 80m lift 1800mm wide 3,0m/sec		@ 4,3°										
High Angle												
Conveyor												
1 off	5000	1	240m	4800	4292	2404	520	3549	3833	1134	-	8516
391m long 240m lift 2100mm wide 3,48m/sec		@ 53°										

COMPARISON OF MAINTENANCE COST BETWEEN CONVEYOR AND HIGH ANGLE CONVEYOR OVER 15 YEARS

TABLE A : BASIC PARAMETERS AND CAPITAL COST SUMMARY

INDICATION OF COSTS SUMMARY

MAINTENANCE COSTS OVER 15 YEARS

R x 1000

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th year
Conventional Conveyors 3 off	878	941	1079	1210	1386	1243	1393	1563	1753	1966	1810	2031	2280	2560	2875
High Angle Conveyor 1 off	403	424	500	561	648	616	691	776	870	977	962	1080	1213	1363	1531

COMPARISON BETWEEN CONVENTIONAL CONVEYOR, HIGH ANGLE CONVEYOR AND DUMPER

C. OPERATING COSTS PER TONNE

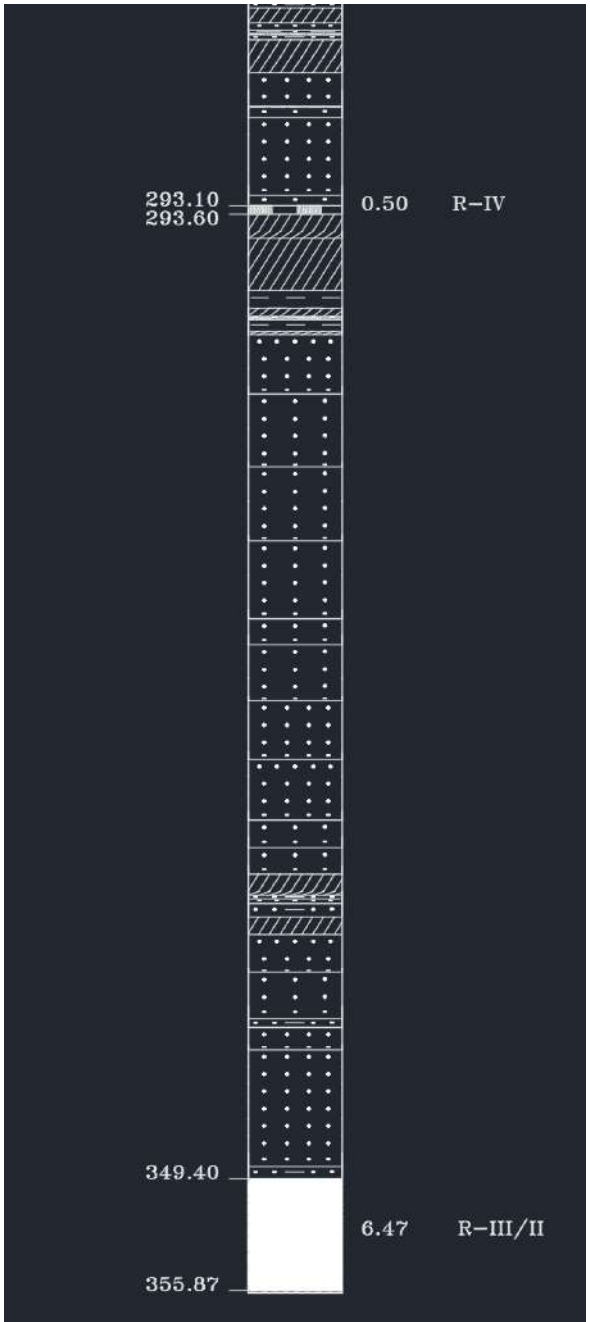
	Conventional Conveyors	High Angle Conveyor
1. Actual operating hours: 6 days at 24 hours per day, 309 days a year =	7 416 hrs per year	7 416 hrs per year
2. Conveyors 1st year maintenance costs =	R878 145	R402 574
Per hour =	R118,41	R54,28
3. Full load power consumption @ R0,037 per kW/hr	4 797 kW R177,49	4 292 kW R158,80
4. Total operating and running costs for 1 hour =	R295,90	R213,08
Cost per tonne @ 5000 tph =	R0,06	R0,04

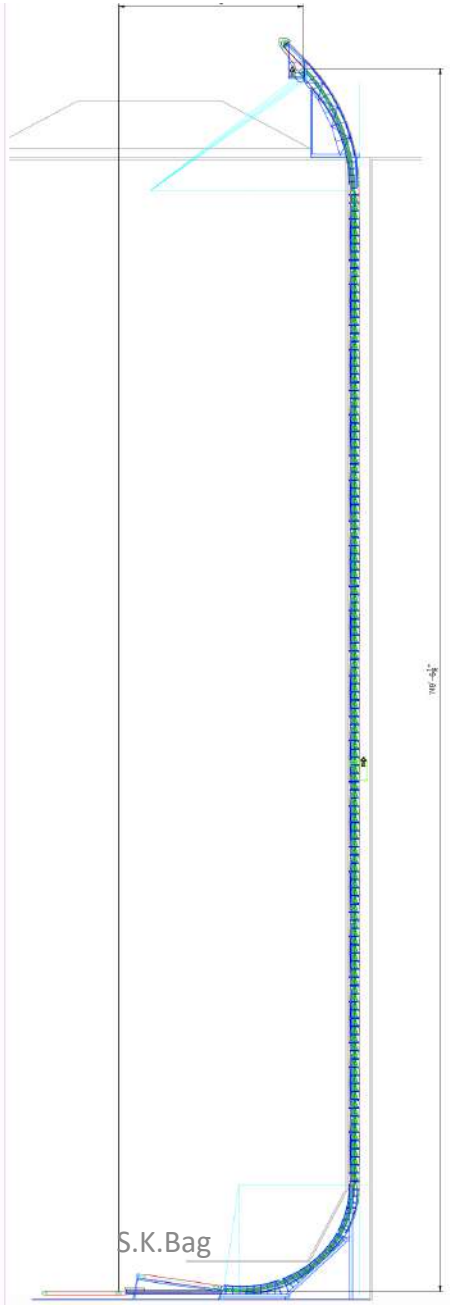
S.K.Bag

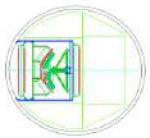
Dumper cost – R 0.41

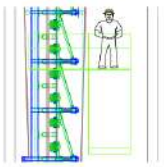
UNDERGROUND APPLICATION
HIGH ANGLE CONVEYOR IN SHAFT FOR JAGANNATHPUR UNDERGROUND COAL MINE OF SHYAM STEEL (APPLICATION OF VERTICAL HIGH ANGLE CONVEYOR)

PROPOSAL FOR DSI HIGH ANGLE CONVEYOR FROM R-III SEAM (6.0 M THICK) 355.87 M BELOW GROUND LEVEL

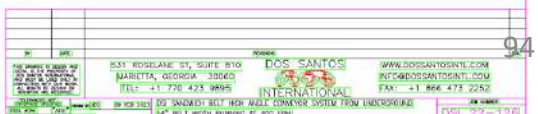








MAN AND MATERIAL IN THE SAME SHAFT

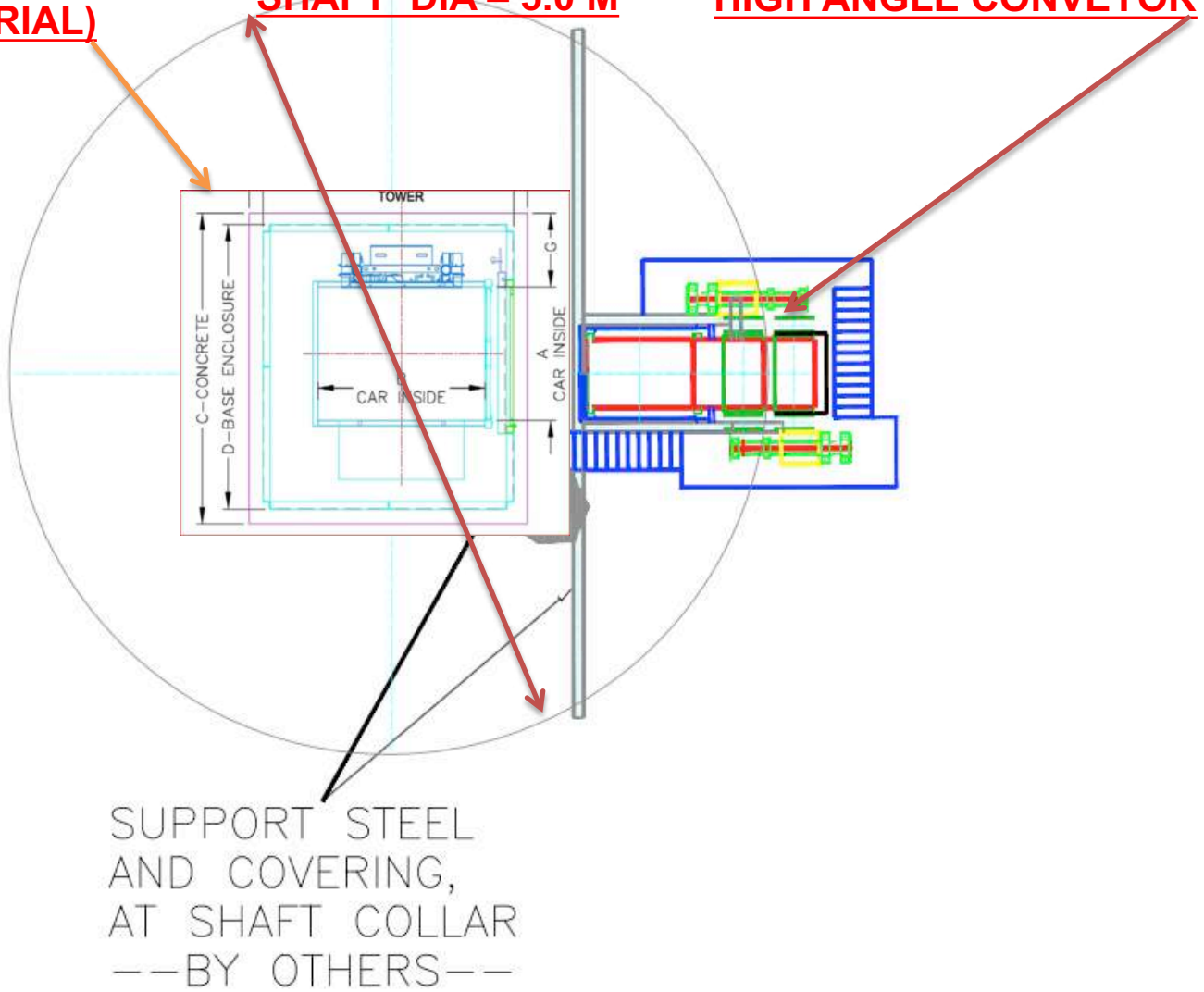


SHAFT DIA SHALL BE 5.0 M (8.0 M FOR SKIP)

RACK & PINION HOIST (FOR MAN & MATERIAL)

SHAFT DIA – 5.0 M

HIGH ANGLE CONVEYOR

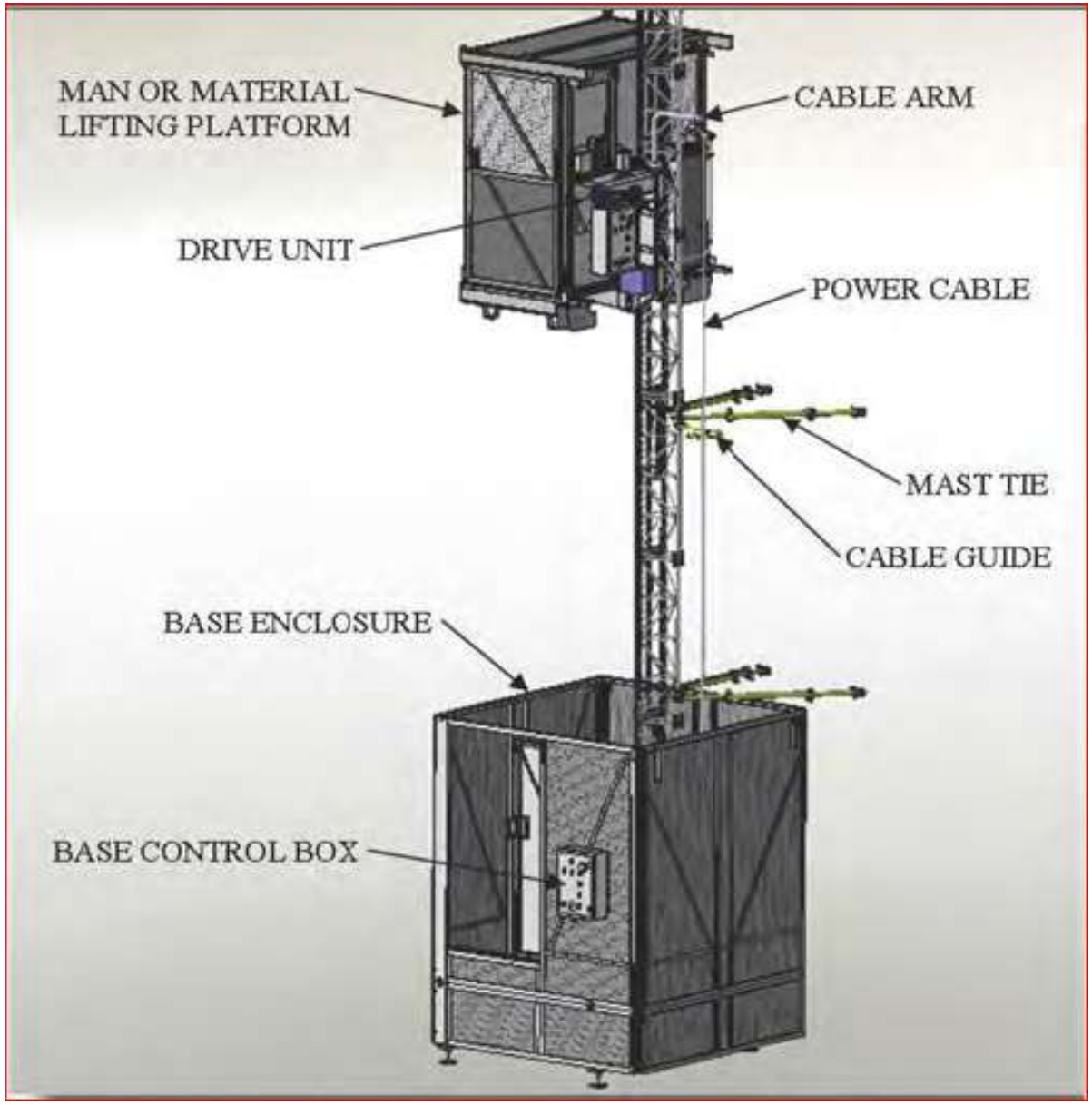


INDUSTRIAL ELEVATOR (RACK & PINION TYPE) SERVICE CAGE

Industrial elevators feature a rack and pinion drive for safe, reliable operation. Elevators are designed for safety. The pinion, which is driven by an electric motor mounted on top of the car, mates with the tower rack allowing the car to travel up or down on command. An electric multiple disc brake on the motor is used to stop travel. A loss of power automatically sets the brake.

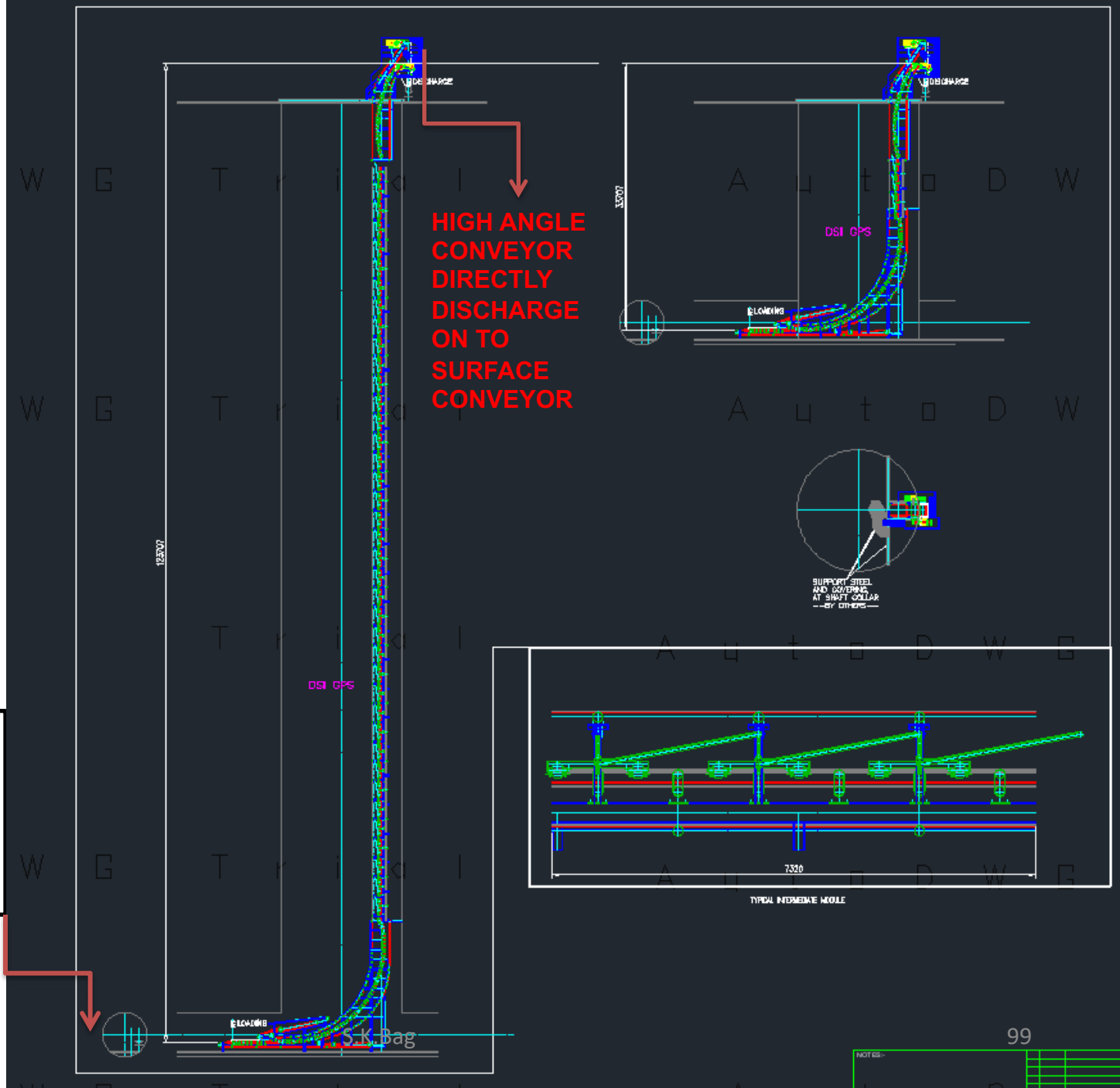
In the event of a power failure, the car can be safely lowered to the nearest landing.

RACK & PINION HOIST FOR MAN & MATERIAL



MAN & MATERIAL CAGE IN THE SHAFT WITH HIGH ANGLE CONVEYOR

VERTICAL TRANSPORT THROUGH SHAFT BY HIGH ANGLE CONVEYOR (90 DEGREE)



U/G CONV. SHALL DIRECTLY DISCHARGE ONTO HIGH ANGLE CONVEYOR


VERTICAL STRUCTURE OF HIGH ANGLE CONVEYOR FROM UNDERGROUND
05.11.2006

DISCHARGE END OF HIGH ANGLE CONVEYOR AT SURFACE – CONVEYOR SHALL DIRECTLY DISCHARGE ON SURFACE CONVEYOR (SKIP HOPPERS, HEADGEAR STRUCTURE, WINDING ENGINE HOUSE AT SURFACE SHALL BE ELEMINATED)

DOS SANTOS INTERNATIONAL

DESIGN BASIS OF HIGH ANGLE CONVEYOR SYSTEM IN SHAFT

For design of HAC system in shaft, first number of flights shall be determined (depending upon shaft depth and belt strength). Based on design parameters, the scheme of the intermediate structure are determined. The intermediate vertical structure from the bottom are designed as a column. The intermediate vertical structure from the top shall be hung from the top including hanging support at one end of the upper station, while the other (tail) end sat on its own support at the shaft bottom making only a positioning connection at the lower transition station.

The intermediate vertical structure are supported as vertical independent tables so that they don't actually touch each other or the bottom transition station or the upper discharge station.

The independent vertical supports may be anchored to the shaft wall. The length of each vertical support will likely be to be determined by the longest steel mill run length of the support channels and the idler/press section spacing.

The support scheme of the rack and pinion type elevator is well established by the elevator manufacturer and must be provided by them after they have developed the elevator for the specific requirements.

It must be determined if the elevator shall be used as the only means to access the DSI GPS or if the system will have intermediate platforms where the elevator can stop.

COMPARISON BETWEEN SKIP WINDER & HAC

	SKIP WINDER**	DSI SNAKE HIGH ANGLE CONVEYOR
MATERIAL	COAL	COAL
DEPTH OF SHAFT	300 M	300 M
PRODUCTION PER HOUR	250 TPH	250 TPH
SHAFT DIA	7.0 M	5.0 M
CAP OF SKIP	7.5 TE	
SPEED OF WINDER/HAC	8 M/SEC	3.0 M/SEC
DRIVE POWER	600 KW	320 KW
BELT WIDTH FOR HAC		1000 MM
ESTIMATED CAPITAL COST (CRORE)	50.00	45.00

NOTE:

1	Estimated capital cost & specification for skip winder has been obtained from authentic source
2	DSI Snake HAC can achieve around 300 TPH @ 3.0 M/SEC
3	Cost of High Angle Conveyor system is including shaft sinking, shaft fittings & man/material rack & pinion type auxiliary cage
4	Estimated annual savings in power cost shall be around 1.5 Cr for HAC

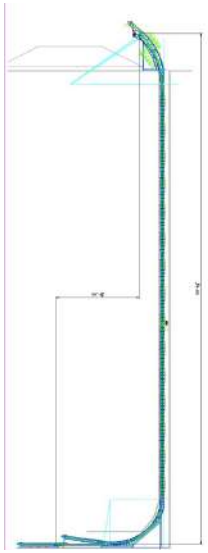
COMPARISON BETWEEN INCLINE & HAC SYSTEM

ALT I – DOG LEGGED INCLINE (FOR LONG INCLINE)

TOTAL DEPTH – 400 M (UPTO BOTTOM SEAM)
LENGTH OF INCLINE IN 1 IN 5 GRADIANT – 2000 M
COST OF INCLINE DRIVAGE @ 2.5 LAKH/M = 2000 X 2.5 = RS 50 CR
CONVEYOR CAPACITY – 1000 TPH
CONVEYOR COST FOR 2000 M (@2.5 LAKH/M) = RS 50 CR – CONVEYOR ROUTE SHALL BE JIG JAG WITH MULTIPLE TRANSFER POINTS (IN-EFFICIENT)
CONVEYOR DRIVE POWER FOR 1400 MM WIDE, 1000 TPH CAP, 400 M LIFT = 1800 KW
LIFE OF BELT = 8 YEARS (STEEL CHORD)
IN-EFFICIENT VENTILATION & LONGER CONSTRUCTION TIME

ALT II – HIGH ANGLE CONVEYOR THROUGH SHAFT

SHAFT DEPTH – 400 M
COST FOR SHAFT SINKING FOR 5.0 M DIA (@ 4.0 LAKH/M) = RS 16 CR
CONVEYOR CAPACITY – 1000 TPH
BELT WIDTH – 2000 MM
HIGH ANGLE CONVEYOR COST = 400 X 12.4 = RS 50 CR
TOTAL DRIVE POWER FOR = 2 x 800 KW
COST OF RACK & PINION CAGE = 30 LAKH
LIFE OF BELT – 16 YEARS
EFFICIENT VENTILATION & LESS CONSTRUCTION TIME



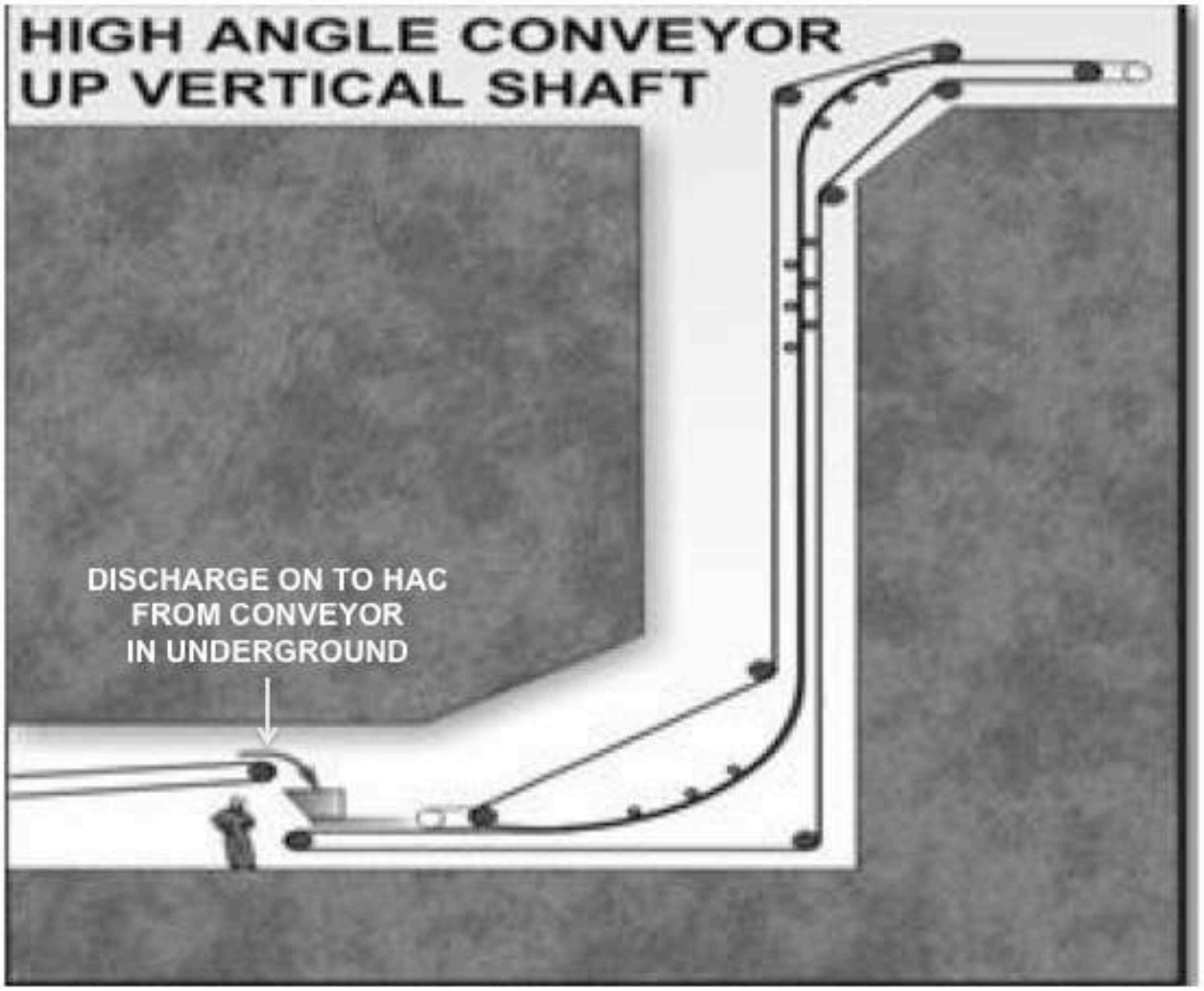
BALASORE CHROMITE MINE

PRESENTLY DUMPER TRANSPORT FROM PIT BOTTOM

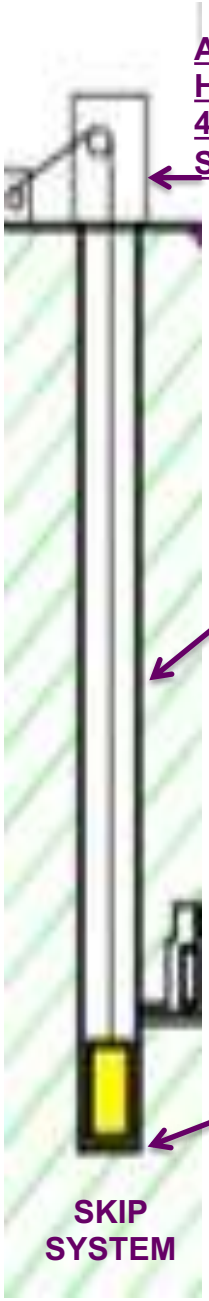
PROPOSAL FOR DSI HIGH ANGLE CONVEYOR IN OPENCAST PORTION

THE ORE SEAM IS EXTENDED BELOW THE GROUND LEVEL VERTICALLY MORE THAN 800 M. ORE IS PRESENTLY EXTRACTED BY OPENCAST UPTO 380 M AND THERE AFTER THROUGH VERTICAL SHAFT

VERTICAL HIGH ANGLE CONVEYOR FOR TRANSPORTING ORE BELOW 380 M



INTEGRATED HAC SYSTEM FROM UNDEGROUND TO SURFACE – COMPARISON WITH SKIP SYSTEM



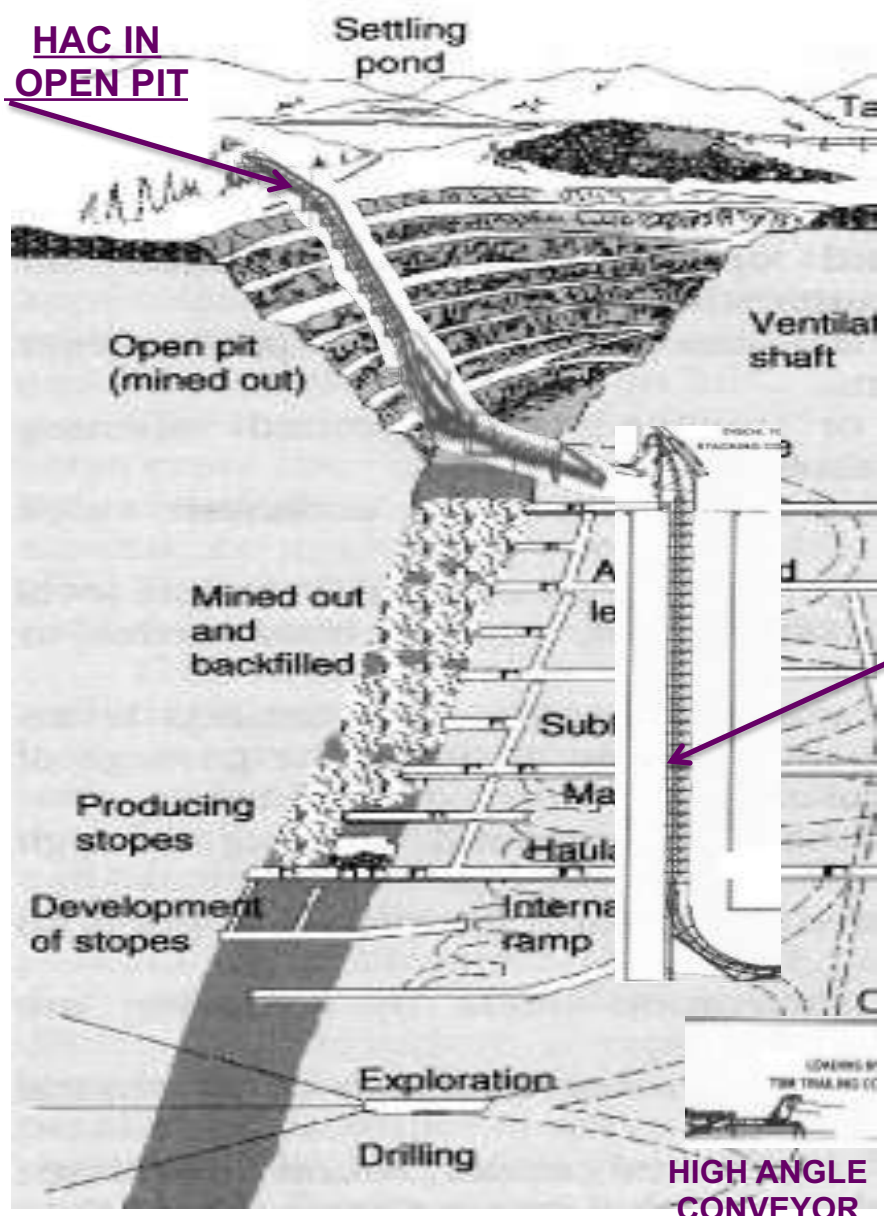
ADDITIONAL HEIGHT OF 40 M AT SURFACE

SHAFT DIA FOR SKIP ~ 8.0M

ADDITIONAL DEPTH OF 40/50 M AT PIT BOTTOM FOR SKIP LOADING

SKIP SYSTEM

HAC IN OPEN PIT



HAC IN SHAFT (DIA – 5 M)

HIGH ANGLE CONVEYOR (HAC) SYSTEM


SCHEME FOR LINKAGE OF THE HAC WITH THE FUTURE VERTICAL TRANSPORT FROM UNDERGROUND (AFTER 4 YEARS)
HAC FROM OPEN PIT TO SURFACE
CONNECTING CONVEYOR
VERTICAL HAC FROM U/G (AFTER 4 YEARS)

CONCEPT OF TRANSPORTING ORE FROM PIT–BOOTOM TO SURFACE BY DSI HIGH ANGLE CONVEYOR FOR JHAMARKOTRA ROCK PHOSPHATE MINE OF RSMML

Presented by Shyamal Kumar Bag

Representative of DSI, USA in India

WRITE-UP

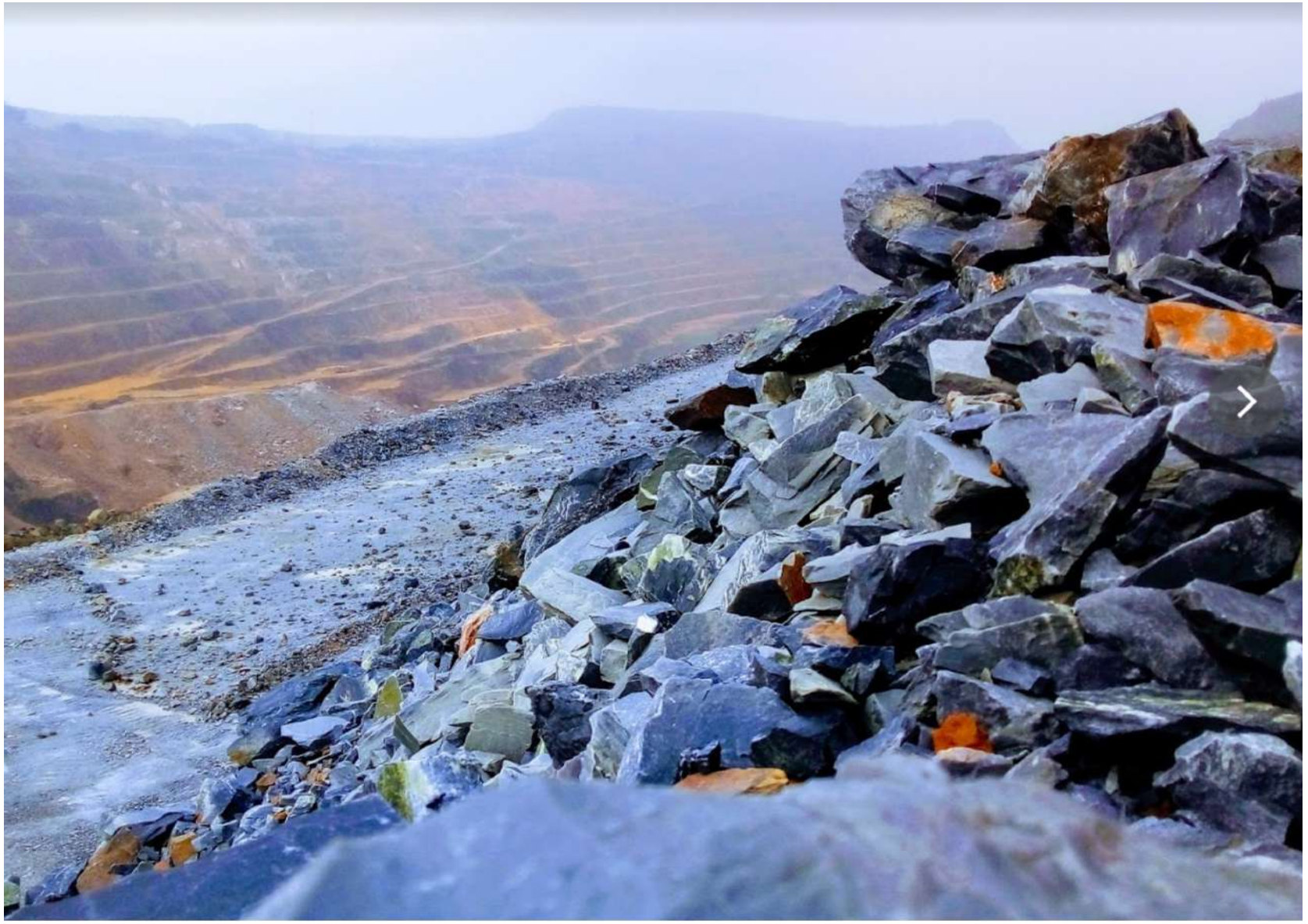
Jhamarkotra Rock Phosphate Mine - The biggest mines (open cast) of Rock phosphate in Asia.

A Phosphate Mine in India owned by RSMML. Rock Phosphate mines at Jhamarkotra & Kanpur Group of Mines are complex deposits. Mining these rock phosphate deposits is far more difficult than that in most parts of the world. Despite the complexities of the deposit, excellent results have been achieved by continuous innovations.

With an annual rock handling of about 20 million tonnes, Jhamarkotra is probably the largest open cast mine in India outside the steel and coal sectors. On technical fronts the problem of ground water had affected the mining operations, until an effective dewatering scheme was evolved and implemented. The geometry of the ore body i.e thin and sharply dipping had resulted in long and narrow pits with great depth extension (Depth/deposit is between 380 and 600 m).

PRESENT MINE

PRESENT MINE



DUMPER TRANSPORT IN BENCHES

DUMPER TRANSPORT FROM PIT-BOTTOM

COST BENEFIT ANALYSIS UPTO 400 M DEPTH OF MINE

COST BENEFIT ANALYSIS DONE FOR COAL IN OPENCAST – SHEET 1

Cost Benefit Analysis of DSI High Angle Conveyor

Calculations showing yearly EMI (MINR) and yearly profit (MINR) for application of DSI high angle conveyor replacing dumper transport in opencast mine.

COMPARISON OF TRANSPORT COST BY DSI SNAKE HIGH ANGLE CONVEYOR, IPCC
AND DUMPER TRANSPORT SYSTEM FROM PIT BOTTOM IN OPENCAST MINE - MINE OPTIMISATION METHOD BY S.K.BAG
SUMMARISED COMPARATIVE STATEMENT FOR SYSTEM - I,II & III

System - I:	In-pit crusher, DSI Snake HAC from pit bottom to surface and dumper shuttle at coal face
System - II:	In-pit crusher, conveyor from in-pit crusher to surface chp and dumper shuttle at coal face to in-pit crusher
System - III:	Dumper transport from coal face to surface and crushing of coal at surface

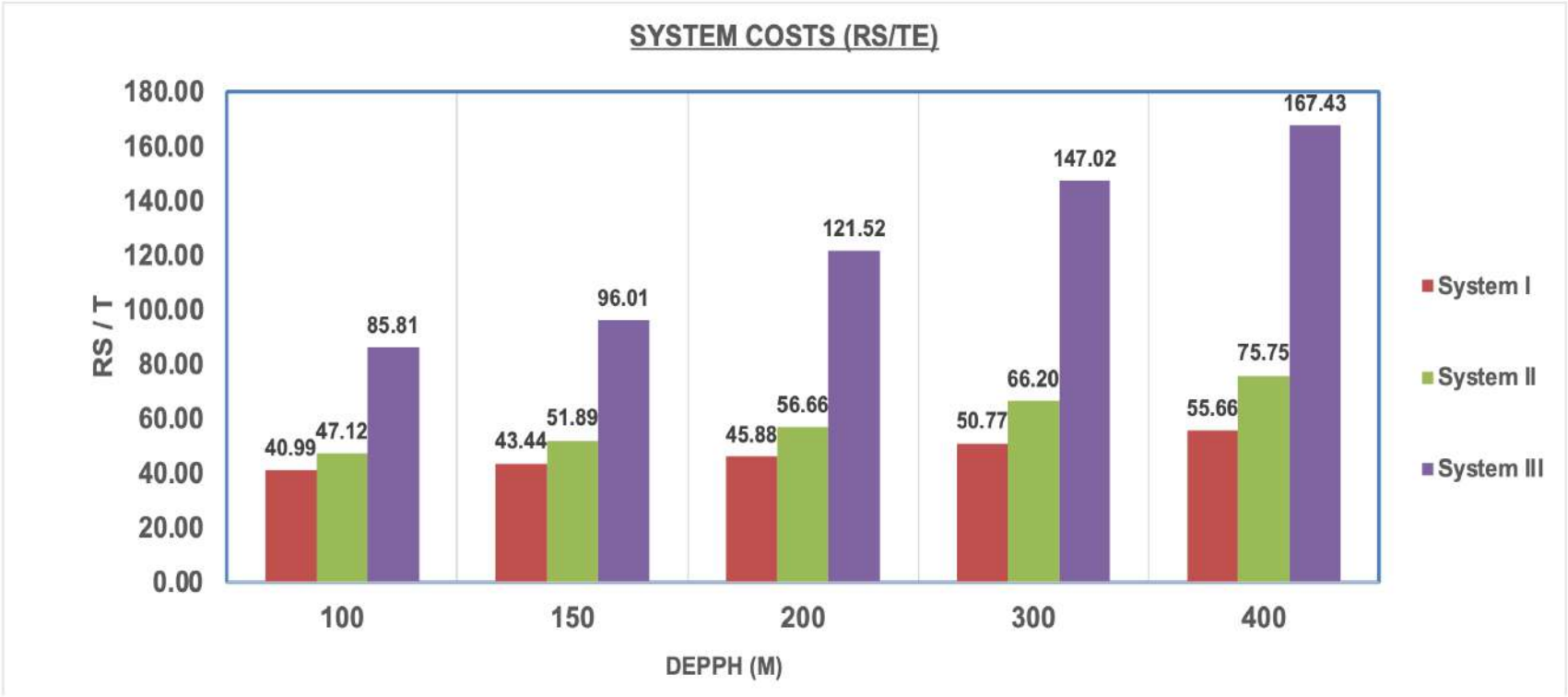
IN-PUT DATA TABLE:

1. Total annual production (MTe)	10.00	9. Annual interest rate (%)	10.00%
2. Capacity of the system (TPH)	1,683.00	10. Annual escalation rate (%)	4.00%
3. Annual operating hours (Hrs)	5,940.00	11. Life of in-pit crusher	18
4. Lead distance of dumper (one way) from coal face to surface chp for System II (kM)	1.52	12. Life of conveyor system (years)	13
		13. Life od DSI HAC system (years)	16
5. Lead distance of dumper (one way) from coal face to in-pit crushing station for System I (kM)	1.00	14. Life of dumper (years)	10
		15. Crushing cost at surface (Rs/Te)	45.00
6.Depth of mine	100.00	16.E. Unit cost per unit	7.00
7. Dumper capacity (Te)	100.00	17. Rate of progess of mine face	2.50%
7. Length of IPC conveyor (meter)	1,520.00	840	10%
8.Length of DSI Snake HAC (meter)	189.70	19. Diesel price (Rs/Lit)	85.00

COST BENEFIT ANALYSIS DONE FOR COAL IN OPENCAST – SHEET 2

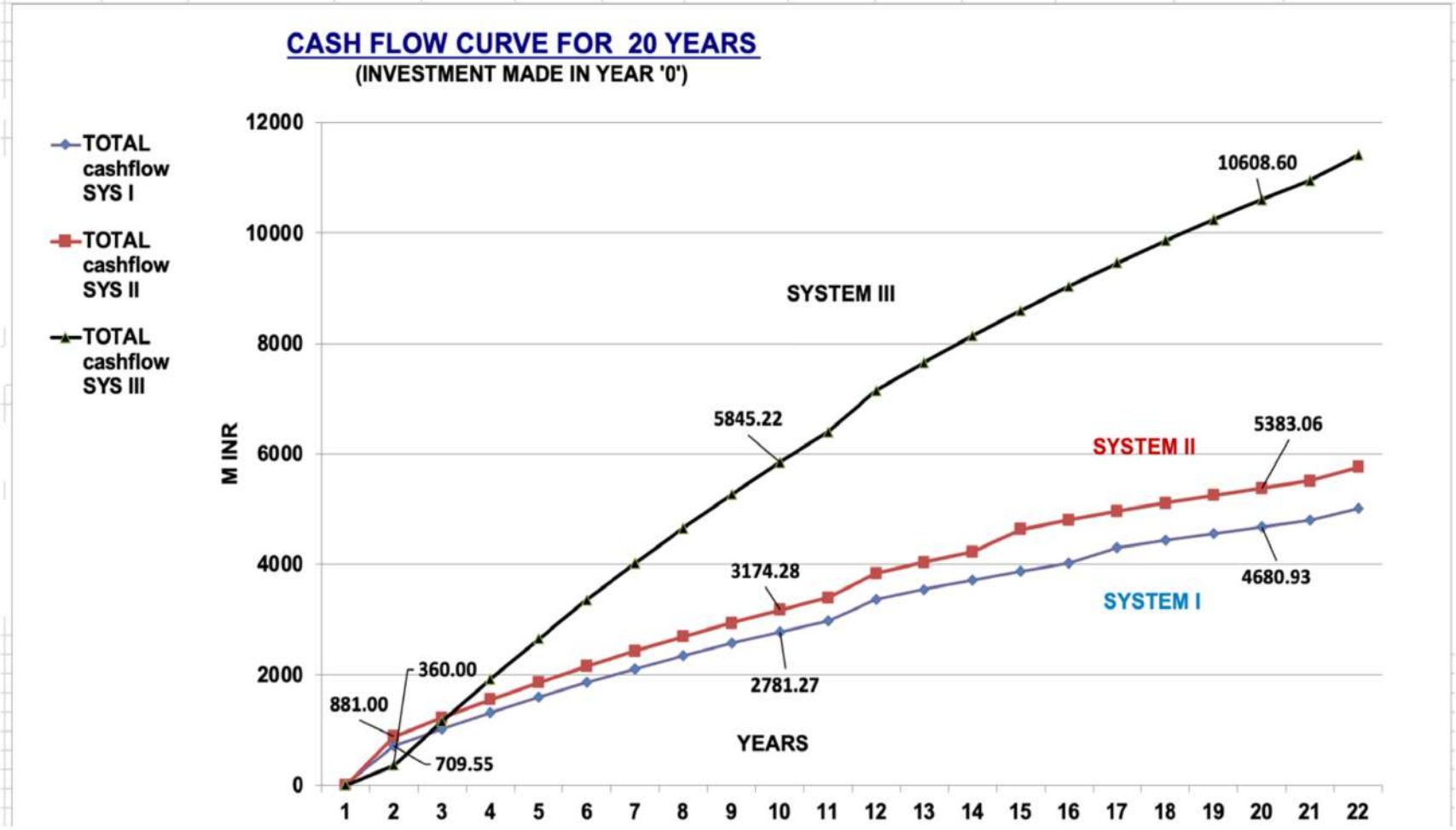
	TABLE SHOWING YEARLY CAPITAL COST AND YEARLY GAIN FOR USING HIGH ANGLE CONVEYOR REPLACING DUMPERS FOR VARIOUS MINE DEPTH							
	60.76		Rs / te				Yearly gain	Total yearly capital cost
Macro command	Annual production (mtpa)	Depth (m)	System I	System II	System III	Diff. between System I and III	(MINR)	(MINR)
CNTRL+SHFT+L	10.00	100	40.99	47.12	85.81	44.82	**448.17**	**60.76**
CNTRL+SHFT+M	10.00	150	43.44	51.89	96.01	52.58	**525.75**	**76.45**
CNTRL+SHFT+N	10.00	200	45.88	56.66	121.52	75.64	**756.37**	**92.14**
CNTRL+SHFT+P	10.00	300	50.77	66.20	147.02	96.25	**962.54**	**123.53**
CNTRL+SHFT+R	10.00	400	55.66	75.75	167.43	111.77	**1,117.70**	**154.91**

COST BENEFIT ANALYSIS DONE FOR COAL IN OPENCAST – SHEET 3



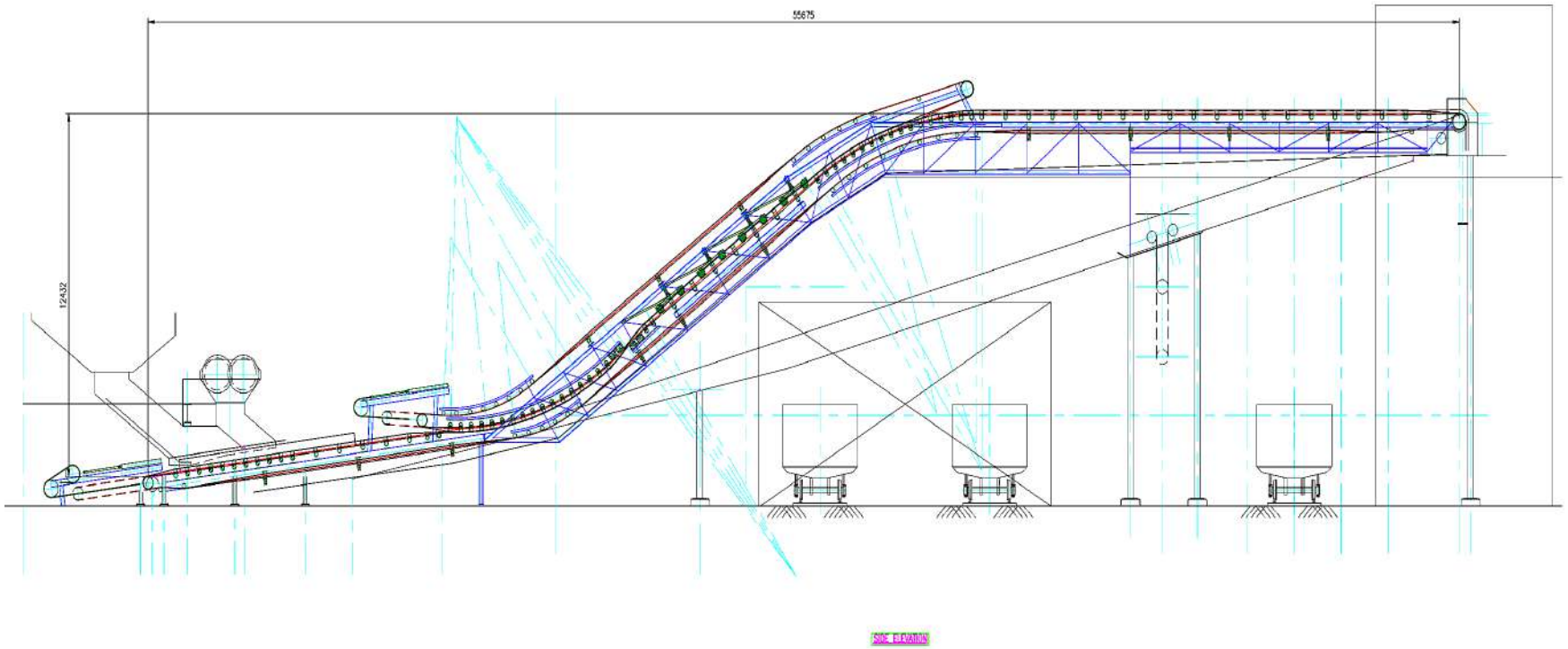
COST BENEFIT ANALYSIS DONE FOR COAL IN OPENCAST – SHEET 4

Annual production	10.00	Mt/a	Depth of Mine	100.00	m



HIGH ANGLE CONVEYOR FOR TISCO PLANT

PROPOSAL FOR DSI CONVEYOR TO CARRY SINTERS OVER TROLLEY LOCOMOTIVES TO GAIN HEIGHT



SIDE ELEVATION

S.K.Bag

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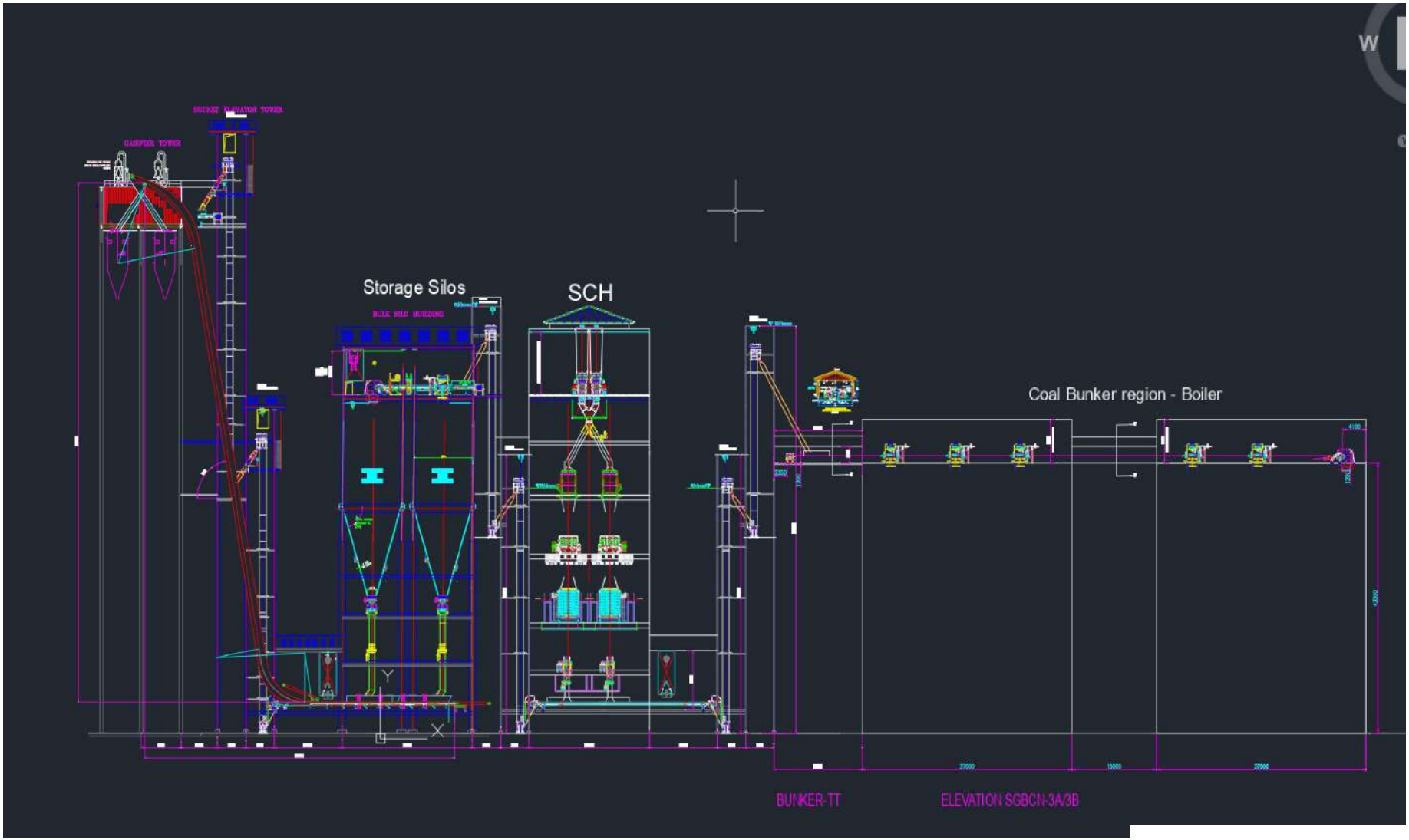
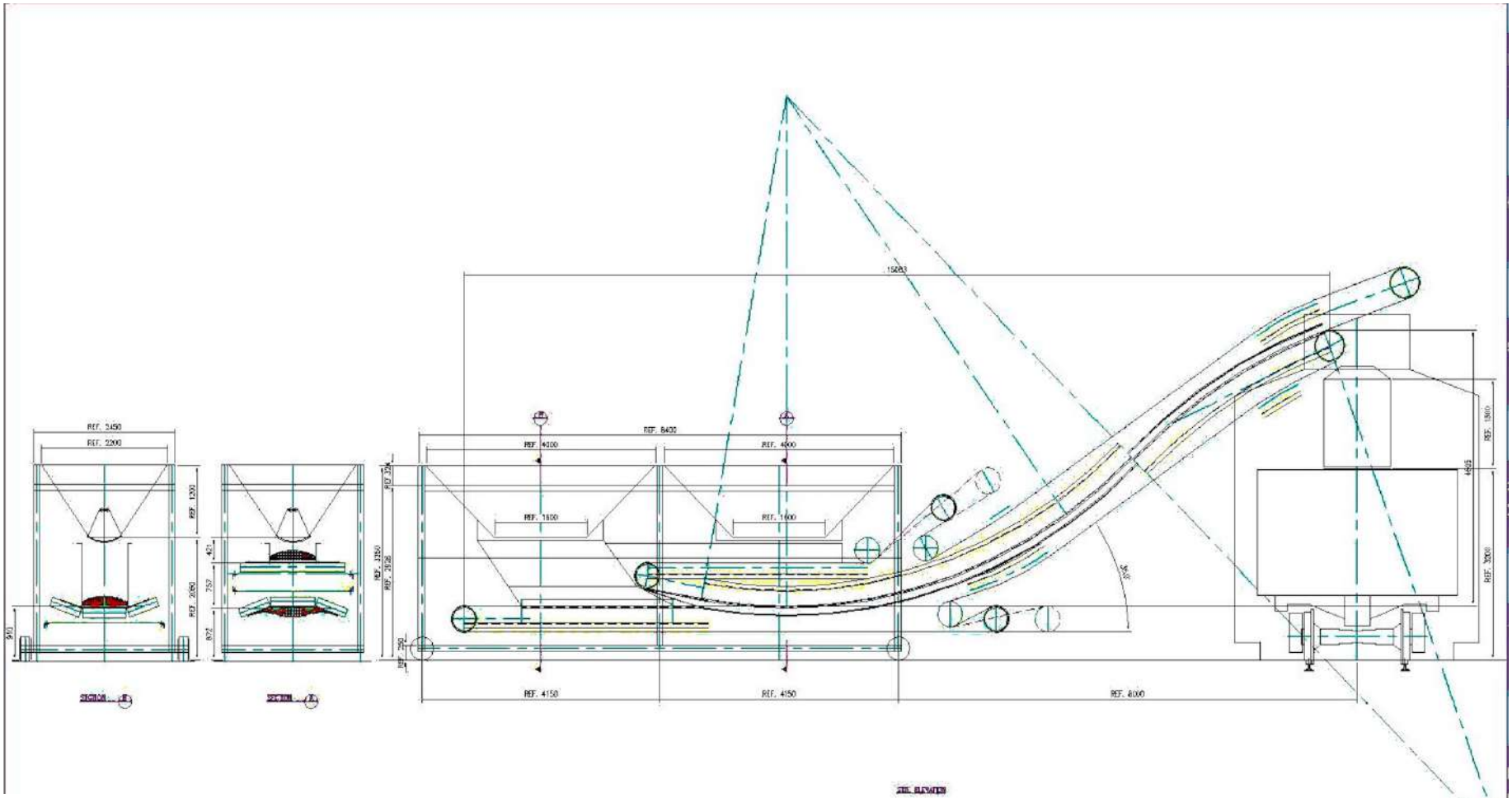
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DSI OFFER FOR SILO LOADING REPLACING POCKET BELT FOR BHEL

DSI 22-119 DWG-MODEL



DSI HIGH ANGLE CONVEYOR AS MOBILE WAGON LOADER



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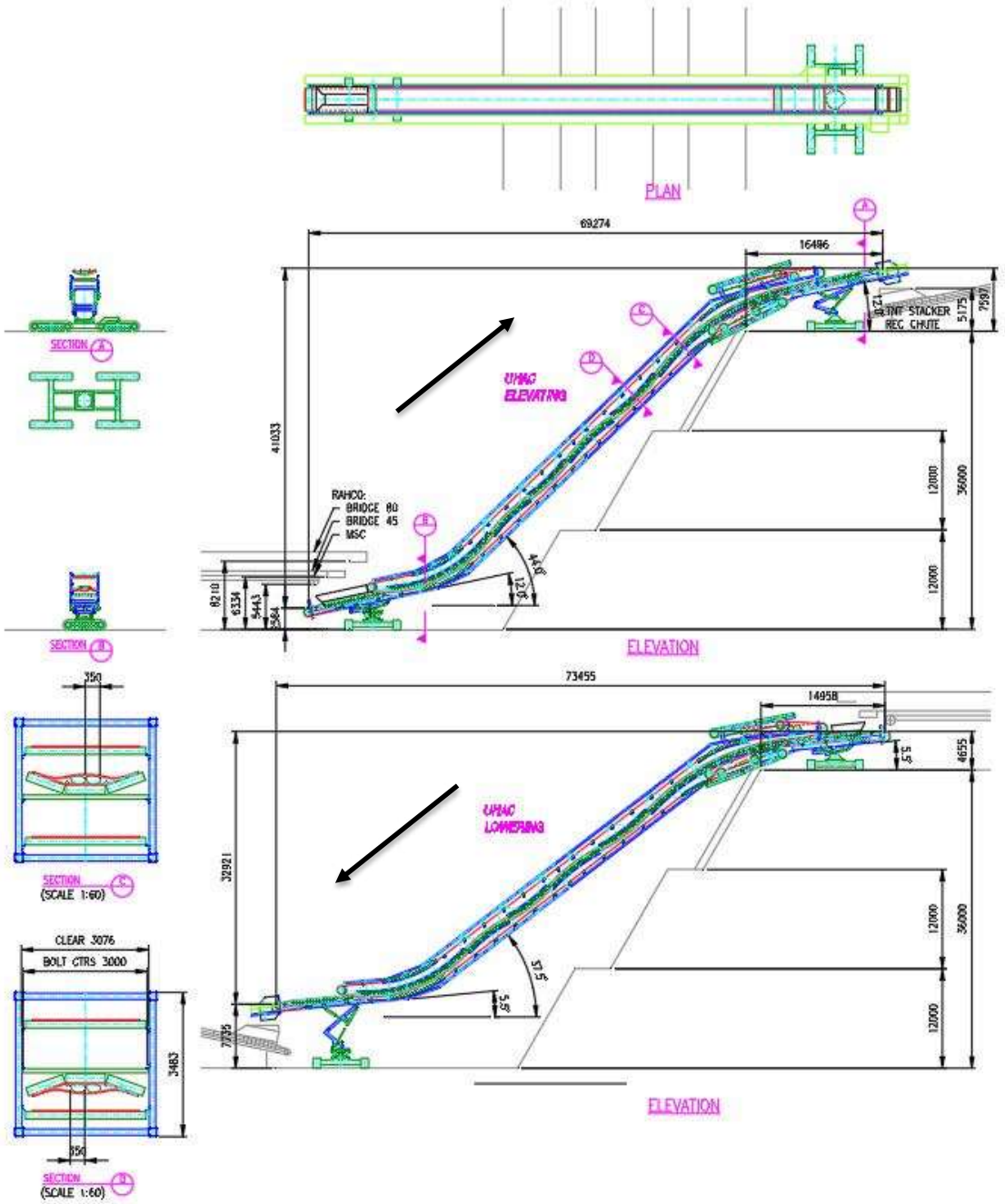
ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

APPLICATION – III
HIGH ANGLE CONVEYOR FOR DOWNHILL TRANSPORT

LAYOUT OF UPHILL AND DOWNHILL HIGH ANGLE CONVEYOR ALONG SIDE WALL IN OPENCAST



DOS SANTOS INTERNATIONAL

OVER 20 YEARS SINCE 1997

DOWNHILL APPLICATION OF HIGH ANGLE CONVEYOR - COMPARISON OF ECONOMICS BETWEEN CONVENTIONAL CONVEYOR & HIGH ANGLE CONVEYOR (CASE STUDY REQUESTED BY SCCL)

DATA TABLE FOR ALT I & ALT II FOR CALCULATION

ALT I	HAC SYSTEM
ALT II	CONVENTIONAL CONVEYOR SYSTEM

	ALT I	ALT II
PRODUCTION (MTPA)	3.5	3.5
ANNUAL OPERATING HOURS	5000	5000
ROUTE LENGTH (M)	450	4800
No.OF UNITS	2	2
NO.OF FLIGHTS	1	4
KW	1800	2400
UNIT COST (Rs)	6.00	6.00
MANPOWER (OPERATION)	2	2
PER UNIT PER FLIGHT PER SHIFT		
MANPOWER (MAINTENANCE) - GROUP	4	8
PER SHIFT		
ANNUAL SALARY (BENEFIT) PER PERSON (LAC)	300000	300000
RATIO OF BENEFIT OF MAINTENANCE CREW	1.2	1.2
LIFE OF BELTING (YEARS)	12	8
RATE OF BANK INTEREST	10%	10%
DISCOUNT RATE	10%	10%
TOTAL INVESTMENT (MINR)	500.00	400.00

ALT I	HAC SYSYEM		HAC + Bench Conveyor + Crusher		Dumper cost (Rs)				
Total production (Million Te)	3.5	Annual operating hours	HAC (450 m profile length)		Total dumper cost calculated with av. round trip distance of 1.5 km @ Rs 12.00 per te per km	HAC + Bench Conveyor + Crusher		M INR /a	Rs / te
700.0	TPH	5,000.0						10.0%	
No.of lines..units >			2		OPERATING LIFE OF PROJECT [YEARS]>			12	
INVESTMENT		M INR	500.00			500.0		500.0	
YEARLY CAPITAL COST		M INR/a	73.38			73.38		73.38	20.97
Length m ... S. Weight t									
ex factory		1000 INR							
erection		1000 INR							
transport									
Elec. Unit cost (Rs)	6.00								
ENERGY COST		M INR/a	91.800			91.800	0.000	91.800	26.23
Installed Power		kW	1,800						
av.Load factor			85%						
ex factory		kW	1,530						
SPARES COST		M INR/a	60.000			60.000	0.000	60.000	17.14
Spares / 1000h		%of Inv	0.90%						
		M INR/a	22.500			22.50	0.00	22.50	6.43
Wearparts/1000h		%of Inv	0.30%						
		M INR/a	7.500			7.50	0.00	7.50	2.14
	3,00,000.00	1.2							
LABOR COST		M INR/a	7.680			7.680	0.000	7.680	2.19
Manning / unit (2 shifts)			8						
Oper.Labor		M INR/a	4.800						
Repair Labor (2 shifts)		Group	8						
Group		Hrs/a							
Repair.Labor		M INR/a	2.880						
CAPITAL & OPERATING COST FOR HAC SYSTEM		MINR / a>	232.86						

TOTAL COST	Rs/Te	66.53
OPERATING COST	Rs/Te	45.57

ALT I

BREAK DOWN COST OF HAC SYSTEM

Rs/ te

Capital	20.97				20.97	31.5%
Energy		26.23			26.23	39.4%
Spare Parts			17.14		17.14	25.8%
Labor				2.19	2.19	3.3%
TOTAL COST	20.97	26.23	17.14	2.19	66.53	100.0%

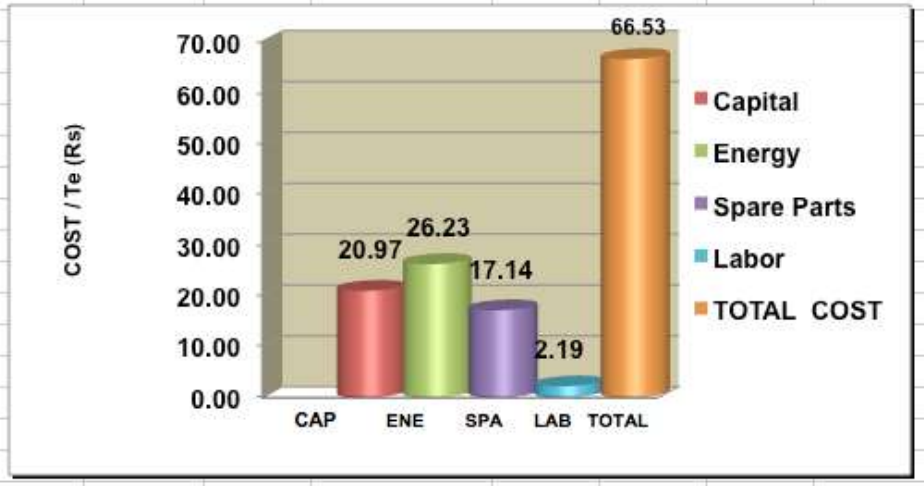
ALT II	CONVENTIONAL CONVEYOR SYSTEM		Conventional Conveyor + Crusher		Dumper cost (Rs)				
Total production (Million Te)	3.5	Annual operating hours	Conveyor (4.8 kM)		Total dumper cost calculated with av. round trip distance of 1.5 km @ Rs 12.00 per te per km	Conventional Conveyor + Crusher		M INR /a	Rs / te
700.0	TPH	5,000.0						10.0%	
	No.of lines..units >		4			OPERATING LIFE OF PROJECT [YEARS] >		8	
INVESTMENT		M INR	400.00			400.0		400.0	
YEARLY CAPITAL COST		M INR/a	74.98			74.98		74.98	21.42
Length m ... S. Weight t									
ex factory		1000 INR							
erection		1000 INR							
transport									
Elec. Unit cost (Rs)	6.00								
ENERGY COST		M INR/a	244.800			244.800	0.000	244.800	69.94
Installed Power		kW	2,400						
av.Load factor			85%						
ex factory		kW	2,040						
SPARES COST		M INR/a	96.000			96.000	0.000	96.000	27.43
Spares / 1000h		%of Inv	0.90%						
		M INR/a	18.000			18.00	0.00	18.00	5.14
Wearparts/1000h		%of Inv	0.30%						
		M INR/a	6.000			6.00	0.00	6.00	1.71
	3,00,000.00	1.2							
LABOR COST		M INR/a	24.960			24.960	0.000	24.960	7.13
Manning / unit (2 shifts)			16						
Oper.Labor		M INR/a	19.200						
Repair Labor (2 shifts)		Group	16						
Group		Hrs/a							
Repair.Labor		M INR/a	5.760						
CAPITAL & OPERATING COST FOR HAC SYSTEM		MINR / a>	440.74			TOTAL COST		Rs/Te	125.93
						OPERATING COST		Rs/Te	104.50

OPEN - PIT MINE OPTIMISATION PROGRAM

Specific Cost / te (Rs) 3.5 Mt/a

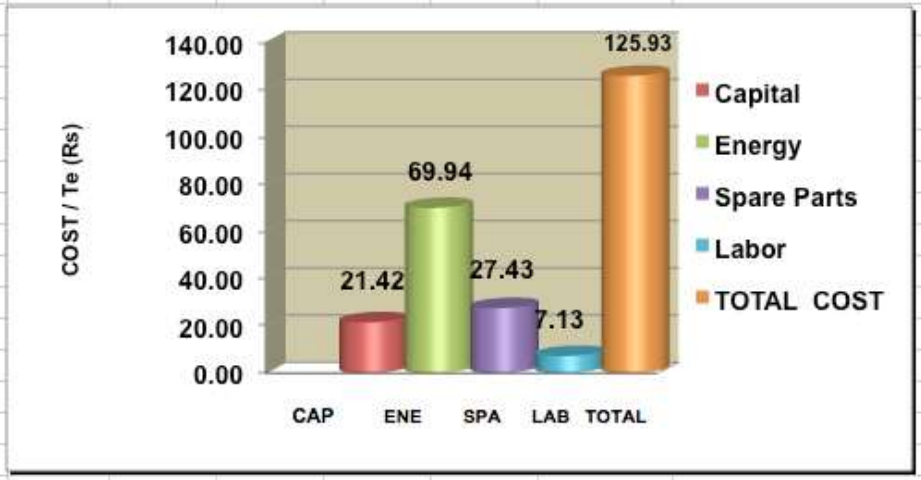
ALTERNATIVE I 66.53 Rs/te

HAC SYSTEM



ALTERNATIVE II 125.93 Rs/te

CONVENTIONAL CONVEYOR SYSTEM



NOTE: ALT II HAS BECOME COSTLIER DUE TO HIFGHER POWER COST, LESS LIFE & HIGHER LABOR COST DUE TO MORE NO. OF CONVEYOR FLIGHTS

S.K.BAG

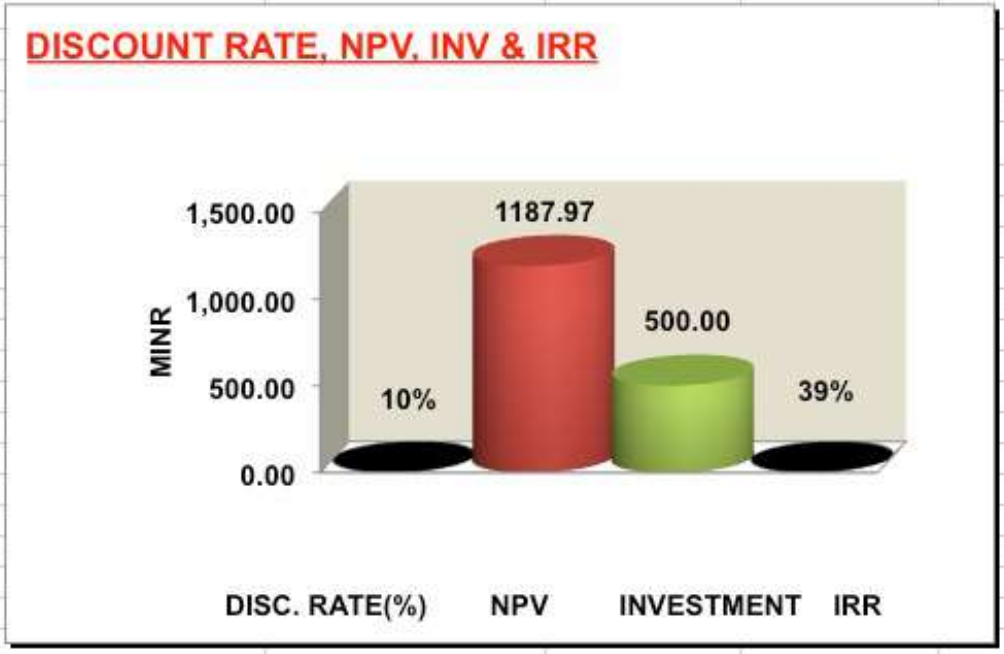
IRR & NPV CALCULATION FOR ALT I (HAC SYSTEM) (INVESTMENT MADE IN '0' YEAR)

		ALTERNATIVE - I (HAC)	ALTERNATIVE - II (CONVEYOR SYSTEM)	DIFFERENCE	NET SAVINGS	ANNUAL PRODUCTION (MTPA)	DISCOUNT RATE FOR NPV
YEAR	CAPITAL INVESTMENT (MINR) FOR ALT - I	OPERATING COST (Rs/Te)	OPERATING COST (Rs/Te)	COST/TE (INR)	MINR	3.50	10%
0 year	-500.00						
1st	206.28	45.57	104.50	58.94	206.28		
2nd	206.28	45.57	104.50	58.94	206.28		
3rd	206.28	45.57	104.50	58.94	206.28		
4th	206.28	45.57	104.50	58.94	206.28		
5th	206.28	45.57	104.50	58.94	206.28		
6th	206.28	45.57	104.50	58.94	206.28		
7th	206.28	45.57	104.50	58.94	206.28		
8th	206.28	45.57	104.50	58.94	206.28		
9th	206.28	45.57	104.50	58.94	206.28		
10th	206.28	45.57	104.50	58.94	206.28		
NPV	1187.97						
IRR	39%						

ALT I (HAC SYSTEM)

DISCOUNT RATE	10%
NPV (MINR)	1187.97
INVESTMENT (MINR)	500.00
IRR	39%

NOTE: IRR & NPV HAVE BEEN SHOWN FOR ONLY 10 YEARS



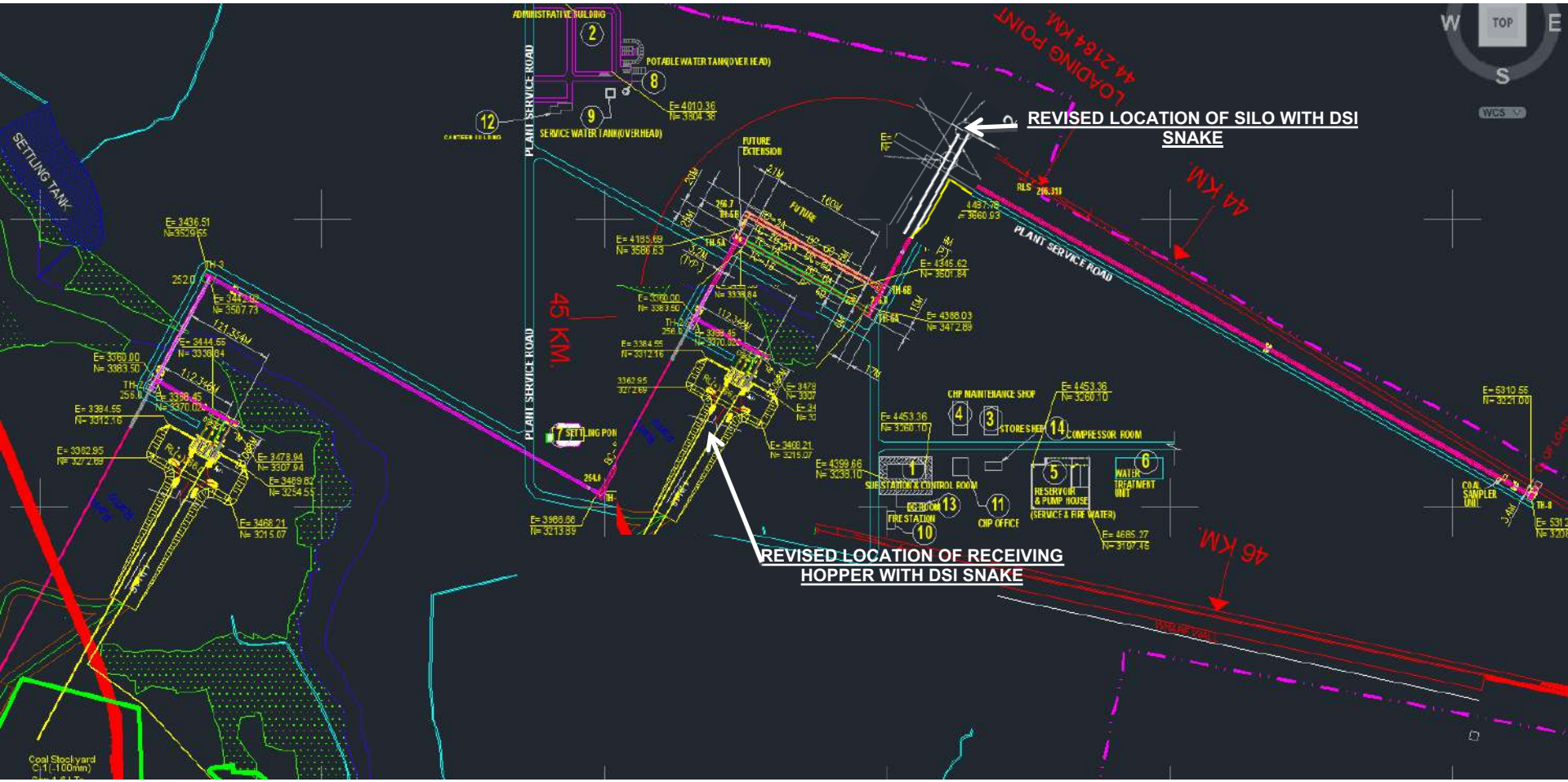
HIGH ANGLE CONVEYOR FOR SILO LOADING IN CHP

DSI HIGH ANGLE CONVEYOR DIRECTLY LOADING INTO SILO

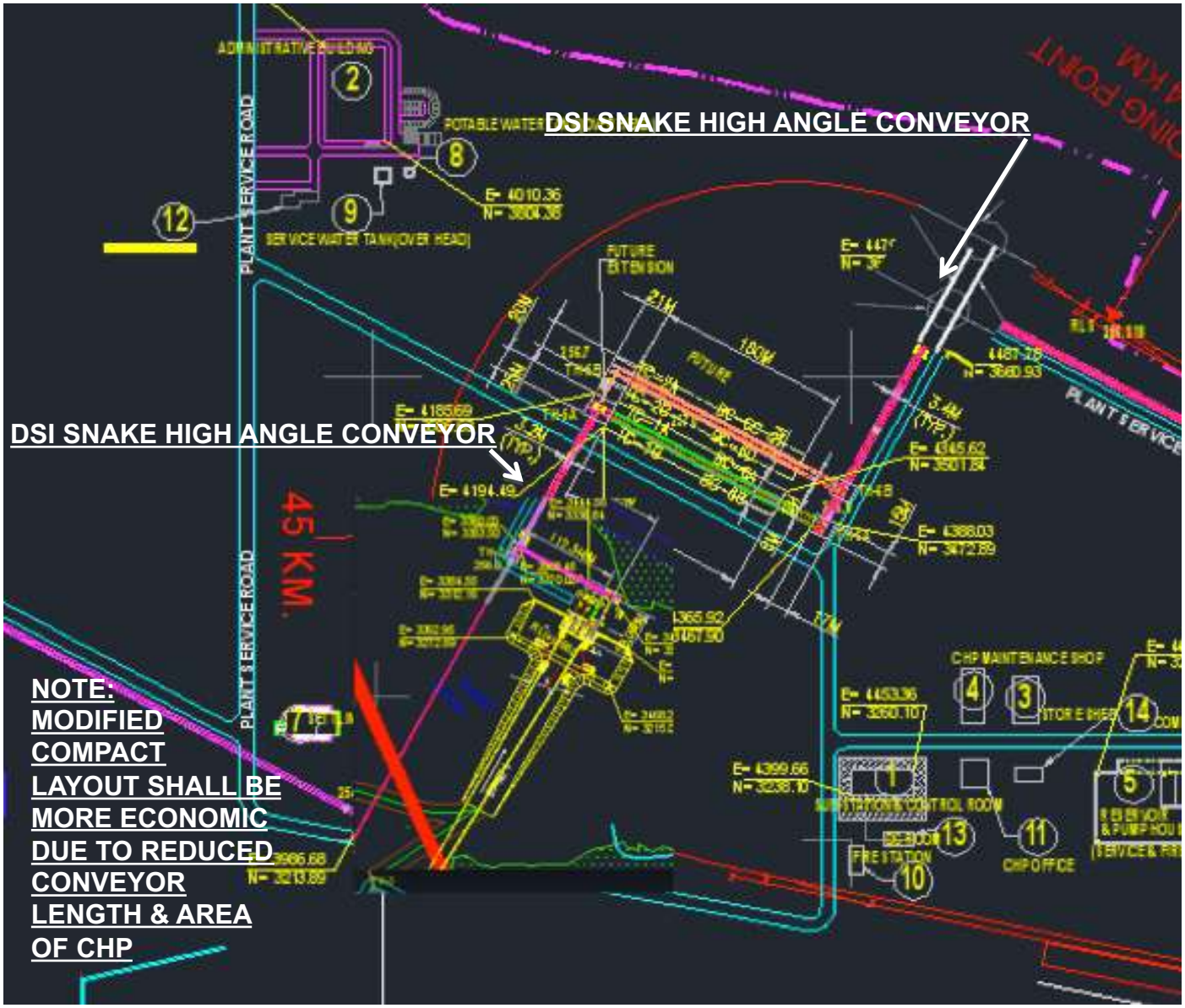
DSI HIGH ANGLE CONVEYOR CAN DIRECTLY DISHARGE COAL, MINERALS, GRAINS INTO SILOS. THE SYSTEM SHALL BE MORE ECONOMIC THAN FEEDING BY CONVENTIONAL CONVEYOR, SINCE, THIS WILL SAVE LAND, LONG CONVEYOR GANTRY, STRUCTURAL STEEL. CONSTRUCTION TIME SHALL BE CONSIDERABLY LESS. LIFE OF DSI HIGH ANGLE CONVEYOR SHALL BE MORE THAN 20 YEARS WITH VERY LOW DEPRECIATION, MAINTENANE, OPERATING COST

LAYOUT OF A CHP FOR OPENCAST PROJECT WITH CONVENTIONAL CONVEYOR

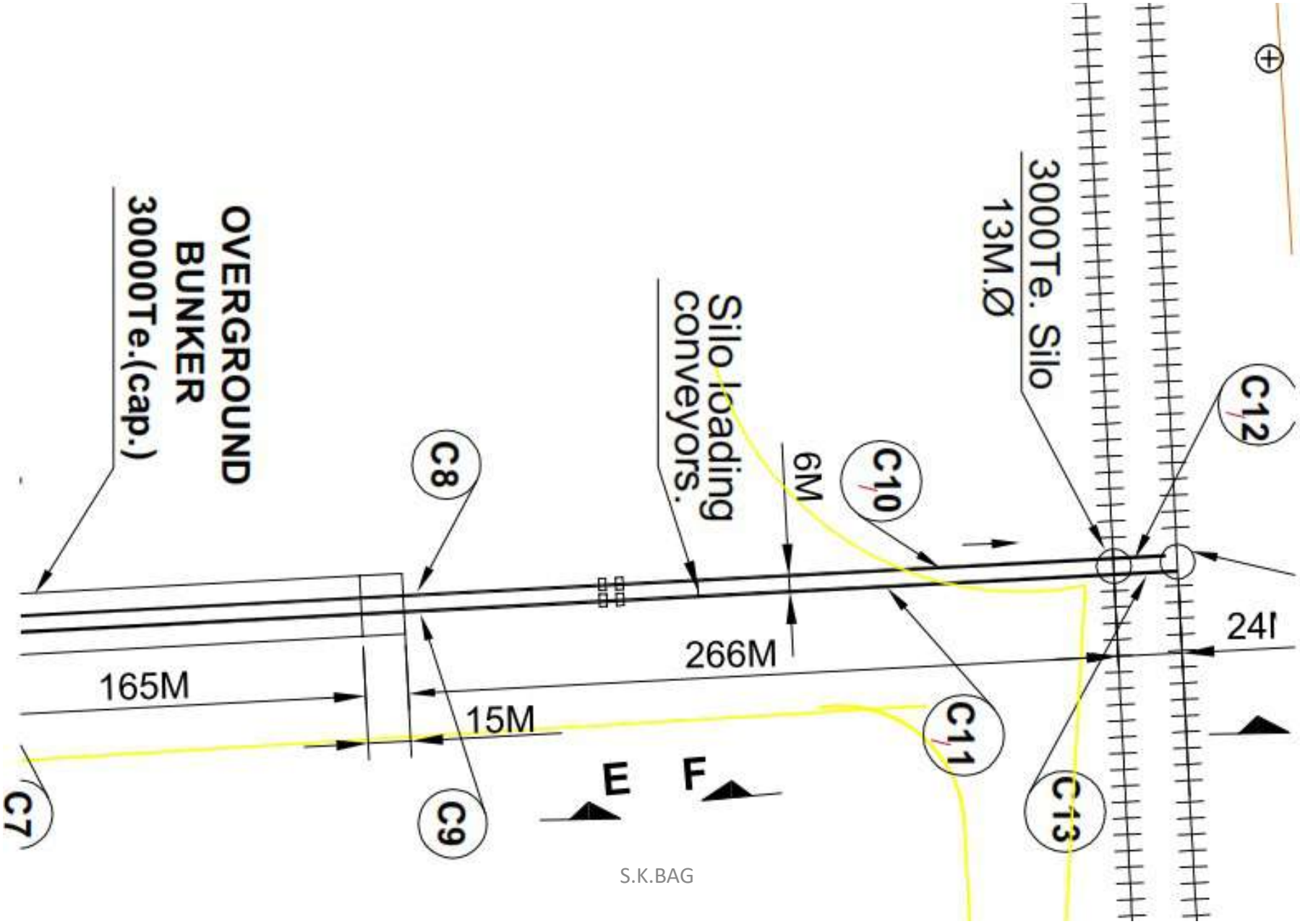
LAYOUT OF CHP MODIFIED WITH DSI SNAKE HIGH ANGLE CONVEYOR



MODIFIED LAYOUT WITH DSI SNAKE HIGH ANGLE CONVEYOR SYSTEM – SAVINGS IN SPACE OF CHP



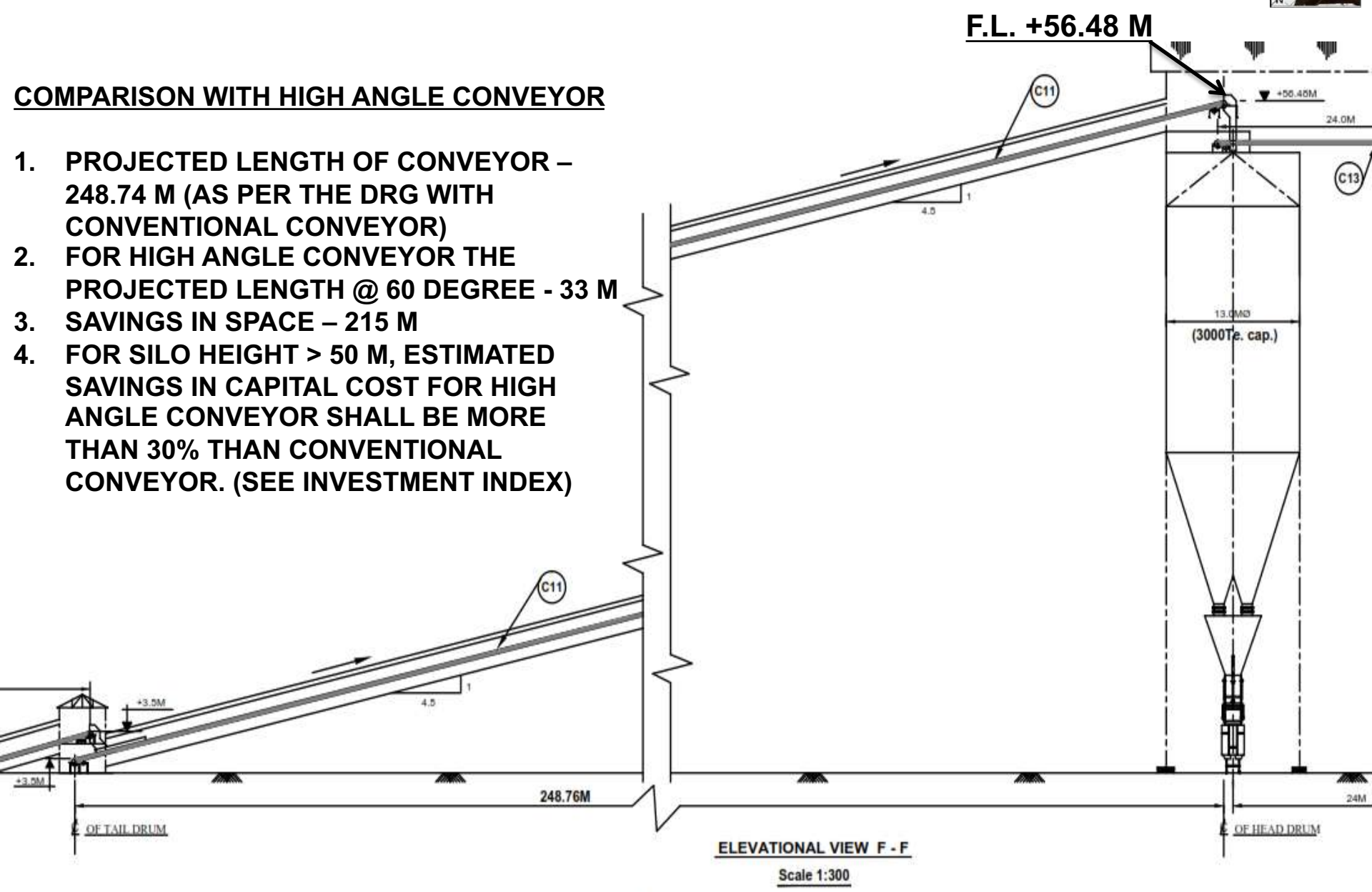
TYPICAL LAYOUT OF SILO LOADING CONVEYOR IN CHP DESIGNED BY CMPDI



CROSS-SECTIONAL ELEVATION OF SILO LOADING CONVEYOR

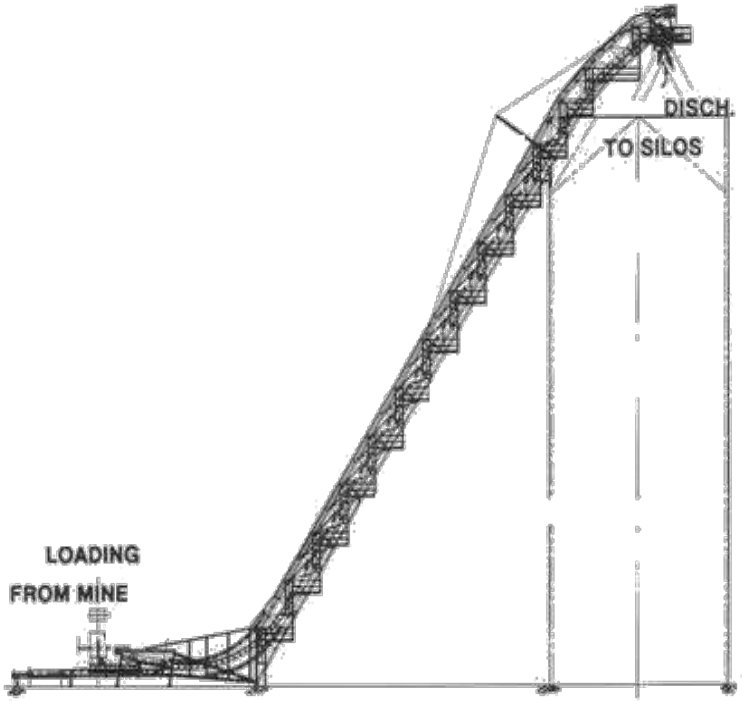
COMPARISON WITH HIGH ANGLE CONVEYOR

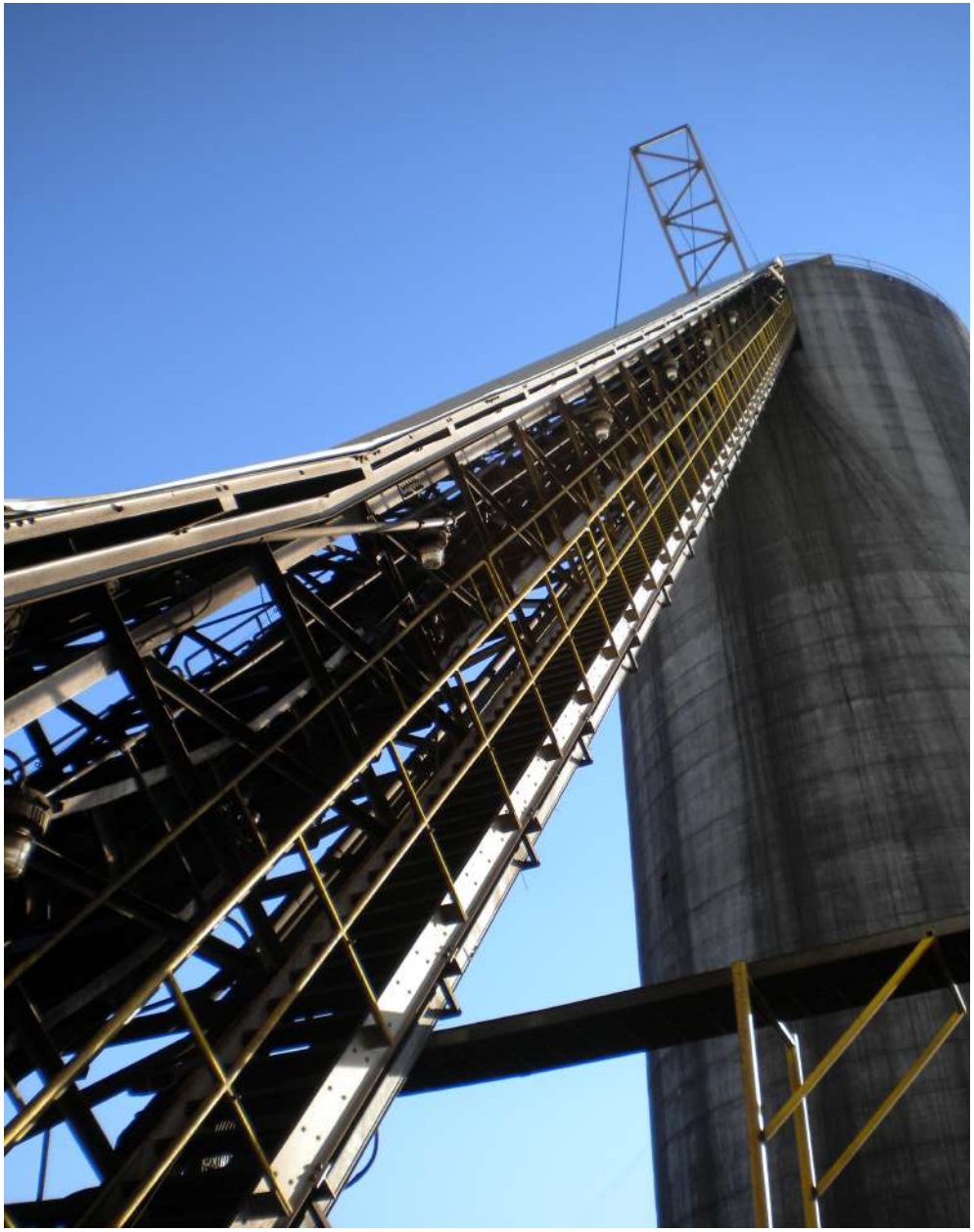
1. PROJECTED LENGTH OF CONVEYOR – 248.74 M (AS PER THE DRG WITH CONVENTIONAL CONVEYOR)
2. FOR HIGH ANGLE CONVEYOR THE PROJECTED LENGTH @ 60 DEGREE - 33 M
3. SAVINGS IN SPACE – 215 M
4. FOR SILO HEIGHT > 50 M, ESTIMATED SAVINGS IN CAPITAL COST FOR HIGH ANGLE CONVEYOR SHALL BE MORE THAN 30% THAN CONVENTIONAL CONVEYOR. (SEE INVESTMENT INDEX)



REQUIREMENT OF LAND FOR LOADING OF SILO WITH CONVENTIONAL CONVEYOR

HIGH ANGLE CONVEYOR FEEDING 54 M HIGH SILO @ 2000 TPH (BLACK HILL POWER PLANT, GILLETTE, WYOMING, USA





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ADVANCING MATERIALS HANDLING
OVER 20 YEARS
SINCE 1997

SILO LOADING BY SANDWICH BELT HIGH-ANGLE CONVEYORS (Cost and power shall be less with minimum Requirement of land)

DOS SANTOS INTERNATIONAL

HIGH ANGLE CONVEYOR FEEDING 54 M HIGH SILO @ 2000 TPH (BLACK HILL POWER PLANT, GILLETTE, WYOMING, USA

THE PARAMETERS OF OF SILO LOADING CONVEYOR IS SIMILAR TO DESIGN OF CMPDI

Sandwich Conveyor
for
Coal Mine, Western USA

Material	- Coal
- Density	- 0.88 t/cu-m (55 PCF)
- Size	- 51 mm (2") minus
Conveying Rate	- 1949 t/h (2150 STPH)
Conveying Angle	- 57 degrees
Belt Width	- 1829 mm (72")
Belt Speed	- 3.81 m/s (750 FPM)
Lift	- 54,200 mm (178')
Length	- 90,800 mm (298')
Drives	
- Top Belt	- 186 kW (250 HP)
- Bottom Belt	- 298 kW (400 HP)

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ADVANCING MATERIALS HANDLING OVER 20 YEARS SINCE 1997

DSI SNAKE HIGH ANGLE CONVEYOR TO LOAD CONCRETE SILO WITH RLS SYSTEM IN CHP

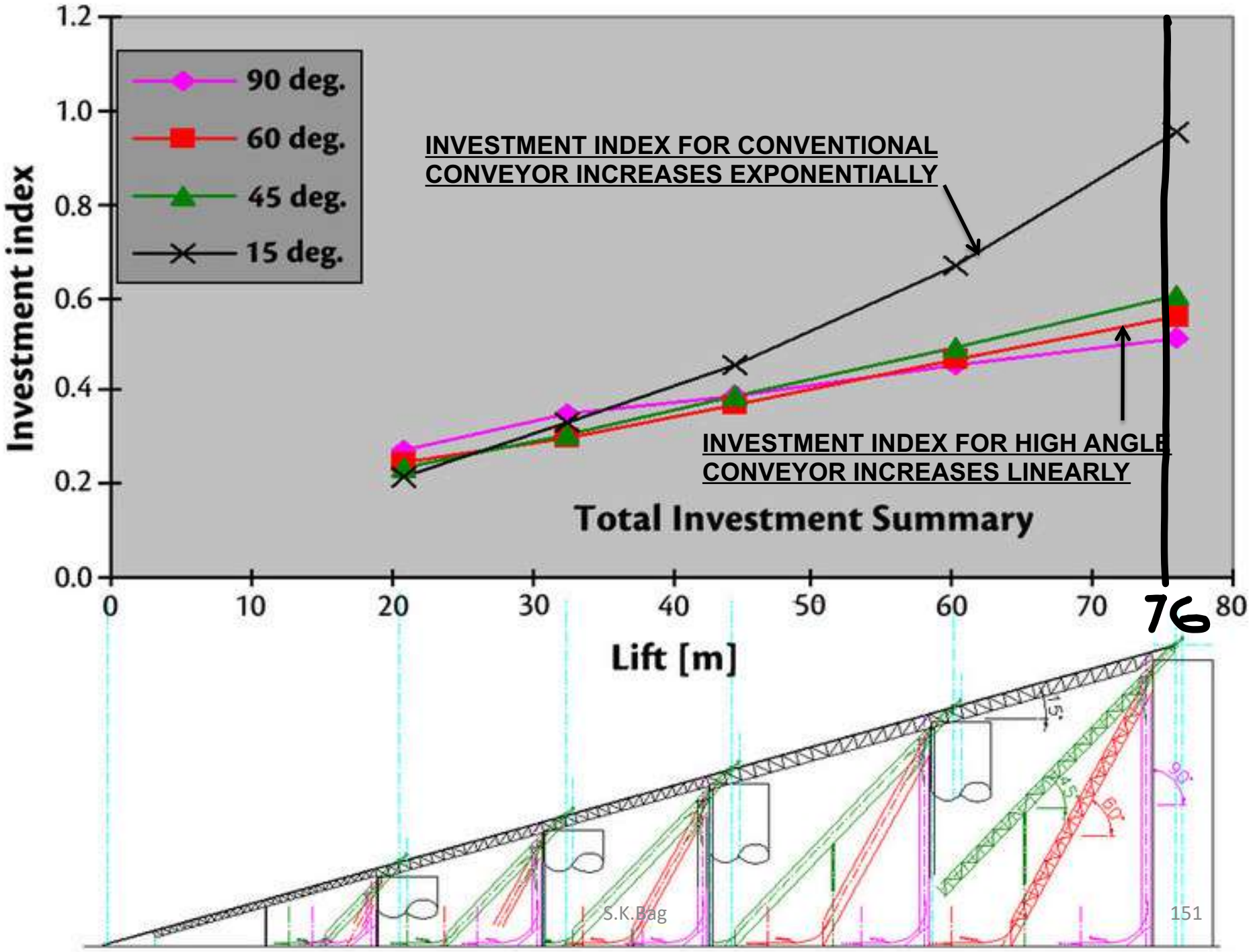
DS
009

Sandwich Conveyor
for
Coal Prep Plant, Eastern USA

Material	- Clean Coal
- Density	- 0.8 t/cu-m (50 PCF)
- Size	- 127 mm (5") minus
Conveying Rate	- 726 t/h (800 STPH)
Conveying Angle	- 90 degrees
Belt Width	- 1372 mm (54")
Belt Speed	- 2.79 m/s (550 FPM)
Lift	- 76,200 mm (250')
Length	- 90,200 mm (296')
Drives	
- Top Belt	- 112 kW (150 HP)
- Bottom Belt	- 112 kW (150 HP)

HEIGHT OF SILO IS MORE THAN CMPDI DESIGN

COMPARISON OF INVESTMENT INDEX FOR DSI SNAKE HIGH ANGLE & CONVENTIONAL CONVEYOR


90 deg.
60 deg.
45 deg.
15 deg.
INVESTMENT INDEX FOR CONVENTIONAL CONVEYOR INCREASES EXPONENTIALLY
INVESTMENT INDEX FOR HIGH ANGLE CONVEYOR INCREASES LINEARLY
Total Investment Summary
Investment index
Lift [m]
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
76
80
15°
45°
60°
90°

COST COMPARISON WITH CONVENTIONAL CONVEYOR

Conventional 15° slope conveyor proves least costly when elevating to the lowest silo of a 17.8 meter height. However, the cost of the conventional conveyor system increases exponentially with height. Beyond approximately 33 meters of lift it becomes the most expensive solution.

At 76 meters of lift its cost exceeds the sandwich belt solutions by a range of 60% to 88%. On the other hand, the variation in investment cost for the sandwich belt solutions is approximately linear with silo height and quite modest with regard to each other. At the highest silo, the vertical sandwich belt system has the lowest investment index at 0.51 compared to 0.56 (10% higher) for the 60° slope and 0.60 (18% higher) for the 45° slope.

It can be seen that the investments increase linearly with height. The vertical sandwich belt conveyors are more economic than conventional conveyor owing to the great difference in structural steel requirements. The steel in this case includes all truss spans, bents, terminal framing, covers, access walkways and stairways, chutes, skirts etc.
Additional savings in cost shall be associated with the displaced projected area, if real estate values are considered.
In case of space restrictions in the plant area, it may not be possible to go for conventional conveyor and high angle conveyor shall be the only solution in such cases.

COMPARISON OF STRUCTURAL STEEL REQUIREMENT BETWEEN DSI SNAKE & CONVENTIONAL CONVEYOR

	1 Conv. Conveyor, 15° Slope			2 DSI Snake, 45° Slope			3 DSI Snake, 60° Slope			4 DSI Snake, 90° Slope		
	At gr. floor area [m^2]	Spatial vol. [m^3]	Upper surf. area [m^2]	At gr. floor area [m^2]	Spatial vol. [m^3]	Upper surf. area [m^2]	At gr. floor area [m^2]	Spatial vol. [m^3]	Upper surf. area [m^2]	At gr. floor area [m^2]	Spatial vol. [m^3]	Upper surf. area [m^2]
A. Lift to 17.8 m silo	400	3547	1815	100	892	631	88	787	538	85	756	499
B. Lift to 29.6 m silo	769	10361	4324	145	2155	1418	115	1709	1088	86	1275	802
C. Lift to 41.4 m silo	1241	22215	7921	192	3999	2541	145	3027	1858	89	1861	1145
D. Lift to 57.2 m silo	2023	47747	14360	667	15210	4601	183	5276	3151	94	2707	1639
E. Lift to 73 m silo	2976	86717	22636	959	27135	7115	221	8075	4741	97	3538	2125

COMPARISON OF MOTOR POWER

	Conv. conveyor 15° slope	DSI Snake 45° slope	DSI Snake 60° slope	DSI Snake 90° slope
Material:		Coal		
Density		0.88 t/m^3		
Size		150 mm max		
Conveying rate		800 t/h		
Conveying angle	15°	45°	60°	90°
Belt width	900 m	1000 mm	1200 mm	1400 mm
Belt speed		3.4 m/s		
A. Lift to 17.8 m silo		20.8 m		
Length	81.3 m	40.1 m	37.7 m	37.1 m
Selected Power	75 kW	90 kW	90 kW	90 kW
B. Lift to 29.6 m silo		32.6 m		
Length	127.0 m	57.3 m	51.6 m	49.6 m
Selected Power	110 kW	110 kW	110 kW	130 kW
C. Lift to 41.4 m silo		44.4 m		
Length	172.7 m	74.6 m	66.0 m	61.9 m
Selected Power	132 kW	150 kW	150 kW	150 kW
D. Lift to 57.2 m silo		60.2 m		
Length	233.7 m	97.8 m	84.4 m	78.3 m
Selected Power	200 kW	180 kW	180 kW	180 kW
E. Lift to 73 m silo		76 m		
Length	294.7 m	121.0 m	103.5 m	94.7 m
Selected Power	200 kW	220 kW	220 kW	220 kW

LESS POWER

LUMP-SIZE VIS-A-VIS WIDTH OF DSI SANDWICH CONVEYOR

HAC LUMP SIZE & WIDTH CHART

HAC BASIC LUMP SIZE CHART (Metric)		
Approximate Maximum Lump Size		
Belt Width mm	Predominantly Lumpy Material	Occasional Lumps < 10 %
	mm	mm
600	68	89
800	91	119
1000	114	148
1200	137	178
1400	160	207
1600	182	237
1800	205	267
2000	228	296
2200	251	326
2400	274	356
2600	296	385
2800	319	415
3000	342	445
3200	365	474

HAC BASIC LUMP SIZE CHART (Imperial)		
Approximate Maximum Lump Size		
Belt Width Inches	Predominantly Lumpy Material	Occasional Lumps < 10 %
	Inches	Inches
24	2.74	3.56
30	3.42	4.45
36	4.10	5.34
42	4.79	6.22
48	5.47	7.11
54	6.16	8.00
60	6.84	8.89
66	7.52	9.78
72	8.21	10.67
78	8.89	11.56
84	9.58	12.45
90	10.26	13.34
96	10.94	14.23
102	11.63	15.12
108	12.31	16.00
114	13.00	16.90
120	13.68	17.78

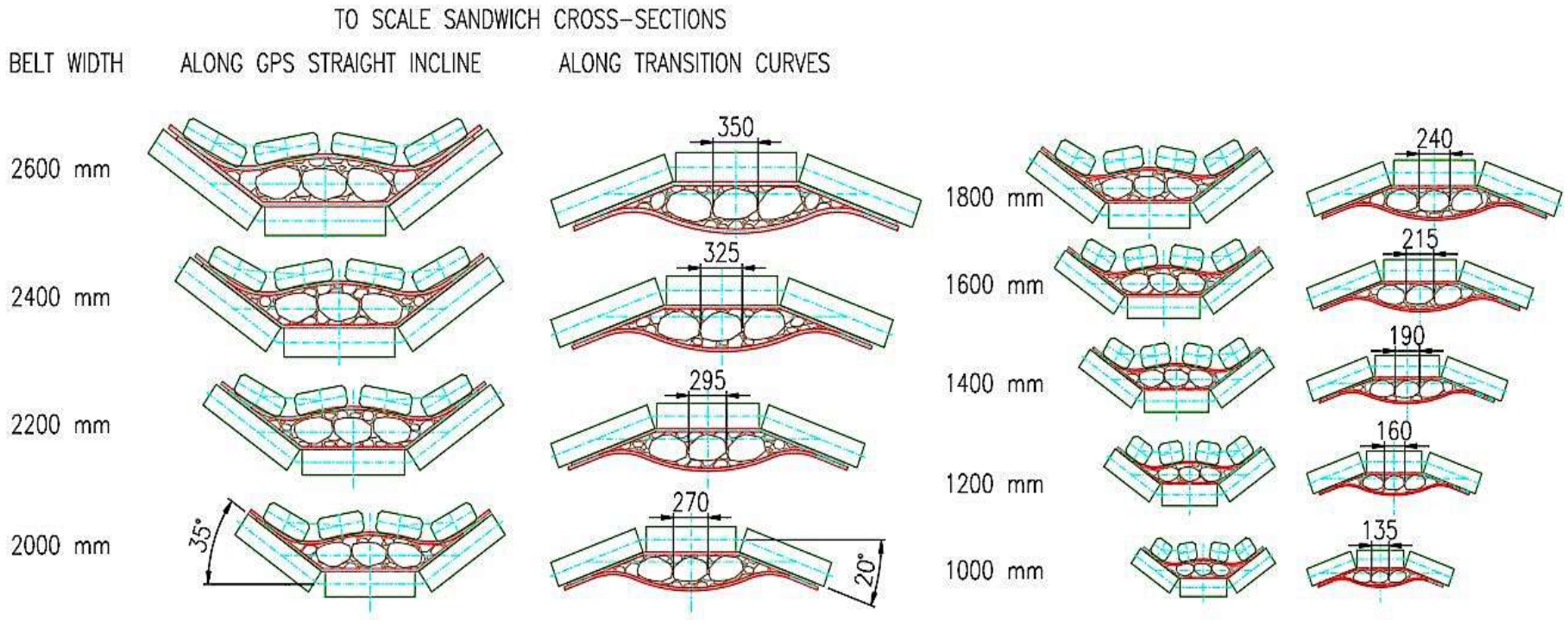
WHAT WILL BE THE MAXIMUM LUMP SIZE FOR HIGH ANGLE CONVEYOR

Recommended Maximum Lump Size:		
Predominantly Lumpy Material (> 10%)	1/9	0.1140 x Belt Width
Occassionaly Lumpy Material (< 10%)	1/7	0.1425 x Belt Width

DSSBI	Material/ Des Rate	BW	Recc Max Lump		Design Lump	Max Lump / Belt Wdth
			>10%	<10%		
	t/h	mm	mm	mm	mm	
DS 001	Var / 2700	1524	174	217	254	0.1667
DS 002	Coal / 2000	1524	174	217	154	0.1010
DS 003	Cu Ore / 4000	2000	228	285	250	0.1250
DS 004	Coal / 2903	1829	209	261	154	0.0842
DS 005	Muck / 272	914	104	130	154	0.1685
DS 011	Coal / 1089	1372	156	196	203	0.1480
DS 012	Refuse / 454	914	104	130	135	0.1477
DS 022	Var / 715	1219	139	174	100	0.0820
DS 023	Coal / 1814	1829	209	261	102	0.0558
DS 024	Gyp Rock / 363	1067	122	152	152	0.1425
DS 026	Coal / 1361	1524	174	217	203	0.1332
DS 027	Coal / 272	1219	139	174	203	0.1665
DS 030	Coal / 1361	1524	174	217	228	0.1496
DS 036	Gold Ore / 689	1219	139	174	250	0.2051
DS 037	Muck / 1266	1372	156	196	152	0.1108
DS 038	RDF / 45.3	1372	156	196	203	0.1480
DS 043	Coal / 136	1067	122	152	152	0.1425
DS 051	Pet Coke / 635	1372	156	196	152	0.1108
DS 065	Var / 3993	2134	243	304	305	0.1429
DS 077	Var / 4264	2134	243	304	152	0.0712
DS 078	Bott Ash / 82	762	87	109	102	0.1339
DS 079	Var /100	762	87	109	100	0.1312
DS 089	Peb Ore / 102	762	87	109	60	0.0787
DS 093	Var / 188	914	104	130	75	0.0821
DS 101	Biomass / 54.4	1067	122	152	102	0.0956
UHAC	Waste Rock / 8000	2600	296	371	350	0.1346

able 7: Various sandwich belt high angle conveyor installations with design lump size against the lump size criteria

WHAT WILL BE THE MAXIMUM LUMP SIZE FOR HIGH ANGLE CONVEYOR



MINE OPTIMISATION PROGRAM

COST CALCULATIONS AND ECONOMIC COMPARISON BETWEEN DUMPER TRANSPORT AND HIGH ANGLE CONVEYOR FOR A 10 MTPA PROJECT AND 100 M DEPTH

PROGRAM DEVELOPED BY S.K.BAG

Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements for 100 m depth

COMPARISON OF TRANSPORT COST BY DSI SNAKE HIGH ANGLE CONVEYOR, IPCC AND DUMPER TRANSPORT SYSTEM FROM PIT BOTTOM IN OPENCAST MINE

SUMMARISED COMPARATIVE STATEMENT FOR SYSTEM - I,II & III

System - I: In-pit crusher, DSI Snake HAC from pit bottom to surface and dumper shuttle at coal face

System - II: In-pit crusher, conveyor from in-pit crusher to surface chp and dumper shuttle at coal face to in-pit crusher

System - III: Dumper transport from coal face to surface and crushing of coal at surface

IN-PUT DATA TABLE:

1. Total annual production (MTe)	10.00	9. Annual interest rate (%)	10.00%
2. Capacity of the system (TPH)	1,683.00	10. Annual escalation rate (%)	4.00%
3. Annual operating hours (Hrs)	5,940.00	11. Life of in-pit crusher	18
4. Lead distance of dumper (one way) from coal face to surface chp for System II (kM)	1.52	12. Life of conveyor system (years)	13
		13. Life od DSI HAC system (years)	16
5. Lead distance of dumper (one way) from coal face to in-pit crushing station for System I (kM)	1.00	14. Life of dumper (years)	10
		15. Crushing cost at surface (Rs/Te)	45.00
6.Depth of mine	100.00	16.E. Unit cost per unit	7.00
7. Dumper capacity (Te)	100.00	17. Rate of progess of mine face	2.50%
7. Length of IPC conveyor (meter)	1,520.00	18. Annual discount rate	10%
8.Length of DSI Snake HAC (meter)	189.70	19. Diesel price (Rs/Lit)	92.00

INVESTMENT (MINR) & SYSTEM COST (RS/TE) — Figures are in 'M INR'

Sl. No.	Items	No. of Dumpers for System I,II & III	System - II	System - III	System - I
1. In-pit crusher, HAC, Conv, Dumpers (System I & II)					
a)	Investment for HAC & IPC (MINR)		456.00		284.55
b)	Investment for in-pit crusher (MINR)		200.00		200.00
c)	No. of Dumpers for System I & II	5	225.00		225.00
	Total capital investment for System I & II		881.00		709.55
2. Dumper transport & Surface chp (System III)					
a)	No. of Dumpers for System III	8			
b)	Total capital investment for dumpers (System II)			360.00	
3	Annual system cost for System I (Rs/Te)		48.72		42.60
4	Annual system cost for System II (Rs/Te)			88.38	
5	Break-up of cost for System - I (Rs/Te)				
i)	In-pit crusher, HAC, IPC (Rs/te) - System I & System II		21.61		15.49
ii)	Dumper shuttle cost (Rs/te) - System I		27.11		27.11

Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements – For HAC system

Total production (Million Te)	Production rate (t/h)	Annual operating hours	2000 mm width / length (meter)	Price of conv. System (Rs / meter)	Dumper cost	In-pit crusher (Capacity - t/h)	HAC + Bench Conveyor	Dumper shuttle	In-pit Crusher		Economic life	M INR /a	Rs / te
10.0	1,683.0	5,940.0	189.70	15,00,000.00	Dumper lead (km)	1683.00						10.0%	10.0%
No.of lines..units >			1		1.0	1			ECONOMIC LIFE [YEARS] > IPC/HAC/Dumper		18	16	10
INVESTMENT		M INR	284.55	No. of dumpers	5	200.00	284.6		200.0			484.6	
YEARLY CAPITAL COST		M INR/a	36.37			24.39	36.37		24.39			60.76	6.08
Length m ... S. Weight t						Price of one in-pit crushing system (MINR)							
ex factory													
erection						200.00							
transport													
Elec. Unit cost (Rs)	7.00												
ENERGY COST		M INR/a	35.34			21.705	35.34	0.00	21.70			57.05	5.70
Installed Power		kW	1,000			900							
av.Load factor			85%			58%							
		kW	850			522							
SPARES COST		M INR/a	20.283			2.376	20.28	0.00	2.38			22.66	2.27
Spares / 1000h		%of Inv	0.90%			0.10%							
		M INR/a	15.21			1.188	15.21	0.00	1.19			16.40	1.64
Wearparts/1000h		%of Inv	0.30%			0.10%							
		M INR/a	5.07			1.188	5.07	0.00	1.19			6.26	0.63
	5,00,000.0	1.2											
LABOR COST		M INR/a	7.20			7.20	7.20		7.20			14.40	1.44
Manning / unit			6			6							
Oper.Labor		M INR/a	3.60			3.60							
Repair.Labor		Group	6			6							
Group		Hrs/a											
Repair.Labor		M INR/a	3.60			3.60							
Total Conveyor cost + IPC cost		MINR / a>	99.20			55.67				TOTAL FOR HAC + IPCC >		154.86	15.49
Dumper transportation cost for System I		MINR /a>			271.11					TOTAL(for dumper shuttle) >			27.11
IPC, Conveyor & Dumper shuttle in-pit		System I								Total for IPC, Conveyor & Dumper shuttle >			42.60

ESTIMATED COST OF HAC

Width (mm)	Total length (m)	Lift (m)	TPH	Belt speed (M/sec)	Conveying angle in degrees	Sin value of conveying angle	Estimated value (MINR)	Exchange rate	Cost/m (INR)	Drive power (kW)
2000.00	189.70	100.00	1683.00	4.20	35.00	0.61	284.55	74.00	1500000.00	2 X 500

Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements for 100 m depth for HAC system

BREAKDOWN OF COST Rs/te

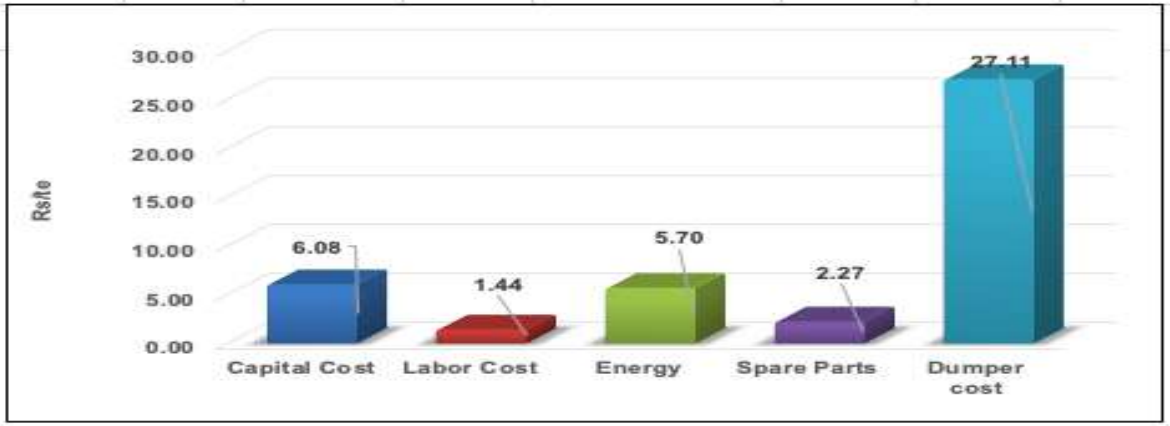
SYSTEM I

HAC, IPC and Dumper shuttle Cost

Capital Cost	6.08					6.08	14.3%
Labor Cost		1.44				1.44	3.4%
Energy			5.70			5.70	13.4%
Spare Parts				2.27		2.27	5.3%
Dumper cost					27.11	27.11	63.6%
TOTAL COST	6.08	1.44	5.70	2.27	27.11	42.60	100.0%

SYSTEM I TOTAL COST 42.60 Rs/te

HAC + IPC + DUMPER SHUTTLE



Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements – For DUMPER system

DATA TABLE	SYSTEM III	Full dumper transport												
	Million Te/Annum	Million Cu.m/Annum	Sp.gravity (te/cu.m)	No. of Dumpers/Shovel	No. of Dumpers/Shovel	Annual production of shovel (Million cu.m)	Dumpers	Dumpers				Stripping ratio	4	
ANNUAL PRODUCTION	10.0	9.09	1.1	For System II	For System I	2.00	SYSTEM II (without in-pit crusher)	SYSTEM I (with in-pit crusher)	Interest rate	Discount rate	Escalation rate	OB Density	2.6	Te/Cu.m
1,683	t/hr	5,940	EFEECTIVE ANNUAL HOURS	8	5		Dumper lead distance (kM)	Dumper lead distance	10.0%	10.0%	4.0%	Density of coal	1.5	Te/Cu.m
Shovel capacity (CU.m)	Dumper capacity (Te)	Dumper lead distance (kM)					1.52	1			Life of dumpers	Annual production of OB	104	Million Te
12.50	100	Total No.of dumpers					8	5			10	No. of working days	330	
INVESTMENT		FOR DUMPERS (MINR)					360.00	225.00						
		ANNUAL CAP.COST FOR DUMPERS	M INR/a				58.59	36.62						
		Capital cost of one dumper	MINR				45.00	45.00						
Depreciation			M INR/a				36.00	22.50						
ENERGY (DIESEL & LUBRICANT)	7.00	92.00												
			M INR/a				337.59	211.00						
Installed Power			BHP				990	990						
av.Load factor														
			BHP											
PARTS (R & M STORES)			M INR/a				14.40	9.00						
LABOR			M INR/a				23.20	14.50						
Manning / unit (CIL)	500000													
Oper.Labor	1.2	2.2					29	18						
			M INR/a				14.40	9.00						
Repair.Labor							18	11						
			M INR/a				8.80	5.50						
INDIRECT COSTS			M INR/a											
Administration O/H (2% of Capital cost)						0.00%	0.00	0.00						
Miscellaneous Expenses - 2.5% of Wage cost-'LAB'						0.00%	0.00	0.00						
- 2% of HEMM (Capital cost)						0.00%	0.00	0.00						
Total working cost M INR/a							375.19	234.50						
Working capital for 4 months			M INR											
Interest on working capital for 4 months @			M INR											
TOTAL DUMPER COST / ANNUM			M INR/a				433.78	271.11						

Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements – Table for cash flow for 20 years

CALCULATION OF CASH FLOW FOR SYSTEM I & II WITH THE ASSUMPTION OF INVESTMENT IN '0' YEAR

DEPTH OF MINE 100.00 M

10.00 MTPA (Annual production) TABLE FOR CASH FLOW (SYSTEM I, II, III)

All costs are in Mio INR

Year		-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DISCOUNT RATE	10%	110%	100%	91%	83%	75%	68%	62%	56%	51%	47%	42%	39%	35%	32%	29%	26%	24%	22%
ESCALATION RATE	4%	96%	100%	104%	108%	112%	117%	122%	127%	132%	137%	142%	148%	154%	160%	167%	173%	180%	187%
combined		106%	100%	95%	89%	85%	80%	76%	71%	68%	64%	60%	57%	54%	51%	48%	46%	43%	41%
Cost increased by distance due to progess		2.5%	100%	103%	105%	108%	110%	113%	115%	118%	120%	123%	125%	128%	130%	133%	135%	138%	140%
IPC, DSI HAC, Dumper shuttle - System I		M INR	Net Cost - not discounted and escalated																
Investment for IPC,DSI HAC & general overhaul		484.55										105.3					284.55		
Investment & replacement cost of Dumper		225.00										225.0							
Dumper haulage cost (fixed)			234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5
ENERGY COST			57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05	57.05
SPARES COST			22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66
LABOR COST			14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40
TOTAL COST			94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11	94.11
IPC, Conveyor, Dumper shuttle - System II		M INR	Net Cost - not discounted and escalated																
Investment for IPC, Conv & general overhaul		656.0										168.7			456.0				
Investment & replacement cost of Dumper		225.0										225.0							
Dumper haulage cost (fixed)			234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5	234.5
ENERGY COST			78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25	78.25
SPARES COST			34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88	34.88
LABOR COST			14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40
TOTAL COST			127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53	127.53
Dumper & crushing cost at surface - System III		M INR	Net Cost - not discounted and escalated																
Investment & Replacement cost for dumpers		360.00										360.00							
Dumper haulage cost by distance (variable)			375.19	384.57	393.95	403.33	412.71	422.09	431.47	440.85	450.23	459.61	468.99	478.37	487.75	497.13	506.51	515.89	525.27
ENE			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PAR			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAB			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHP COST (Rs/te)	45.00		450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0

Year		-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
discounted & escalated :		INVESTMENT																	
TOTAL Oper.Cost SYS I		709.55	328.60	310.68	293.73	277.71	262.56	248.24	234.70	221.90	209.80	397.72	187.53	177.30	167.63	158.49	279.60	141.67	133.9
TOTAL Oper.Cost SYS II		881.00	362.03	342.28	323.61	305.96	289.27	273.49	258.58	244.47	231.14	456.19	206.61	195.34	417.31	174.61	165.09	156.08	147.5
TOTAL Oper.Cost SYS III		360.00	825.19	789.05	754.40	721.17	689.33	658.82	629.58	601.58	574.75	766.37	524.47	500.92	478.38	456.81	436.17	416.43	397.5
cumulated																			
TOTAL cashflow SYS I		709.55	1038.16	1348.83	1642.57	1920.28	2182.84	2431.08	2665.78	2887.68	3097.48	3495.20	3682.73	3860.04	4027.67	4186.16	4465.76	4607.43	4741.3
TOTAL cashflow SYS II		881.00	1243.03	1585.31	1908.92	2214.88	2504.16	2777.65	3036.22	3280.70	3511.83	3968.02	4174.63	4369.97	4787.28	4961.89	5126.98	5283.06	5430.6
TOTAL cashflow SYS III		360.00	1185.19	1974.24	2728.64	3449.82	4139.15	4797.97	5427.55	6029.13	6603.88	7370.24	7894.71	8395.63	8874.01	9330.83	9767.00	10183.43	10580.9

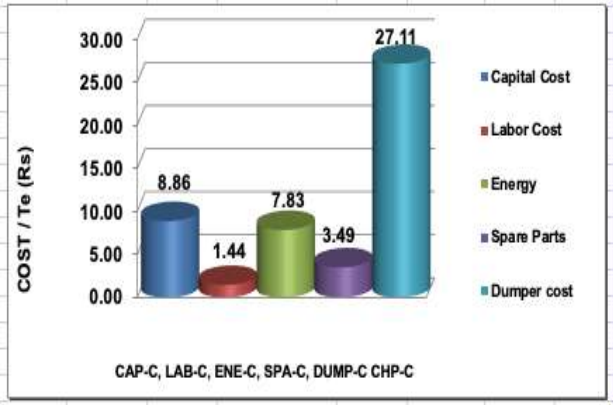
Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements – System cost/ton

OPEN - PIT MINE OPTIMISATION PROGRAM

Specific Cost / te (Rs) 10.0 Mt/a Mine depth 100.00 m

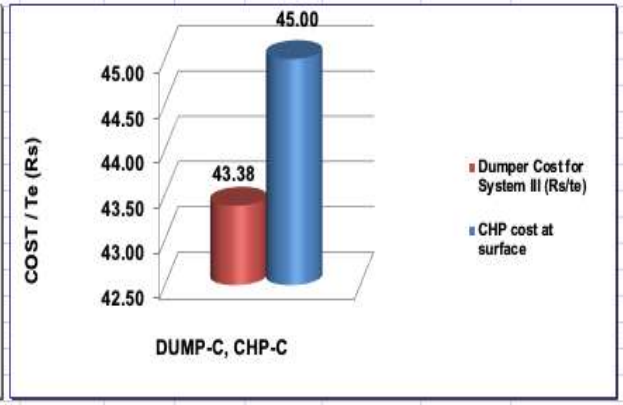
SYSTEM II 48.72 Rs/te

IPCC & DUMPER SHUTTLE



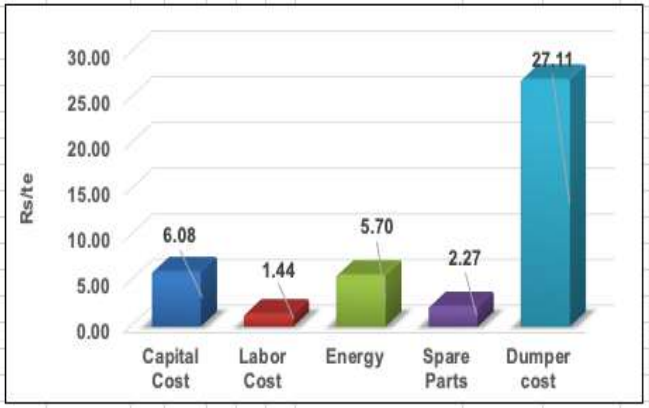
SYSTEM III 88.38 Rs/te

DUMPER TRANSPORT & SURFACE CRUSHING

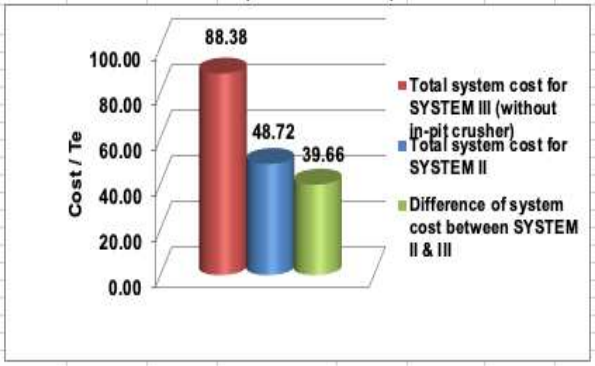


SYSTEM I TOTAL COST 42.60 Rs/ te

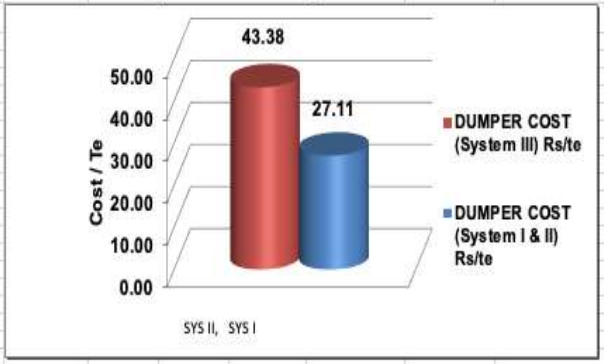
HAC + IPC + DUMPER SHUTTLE



DIFFERENCE IN SYSTEM COST (SYSTEM III & II) 39.66 Rs/te



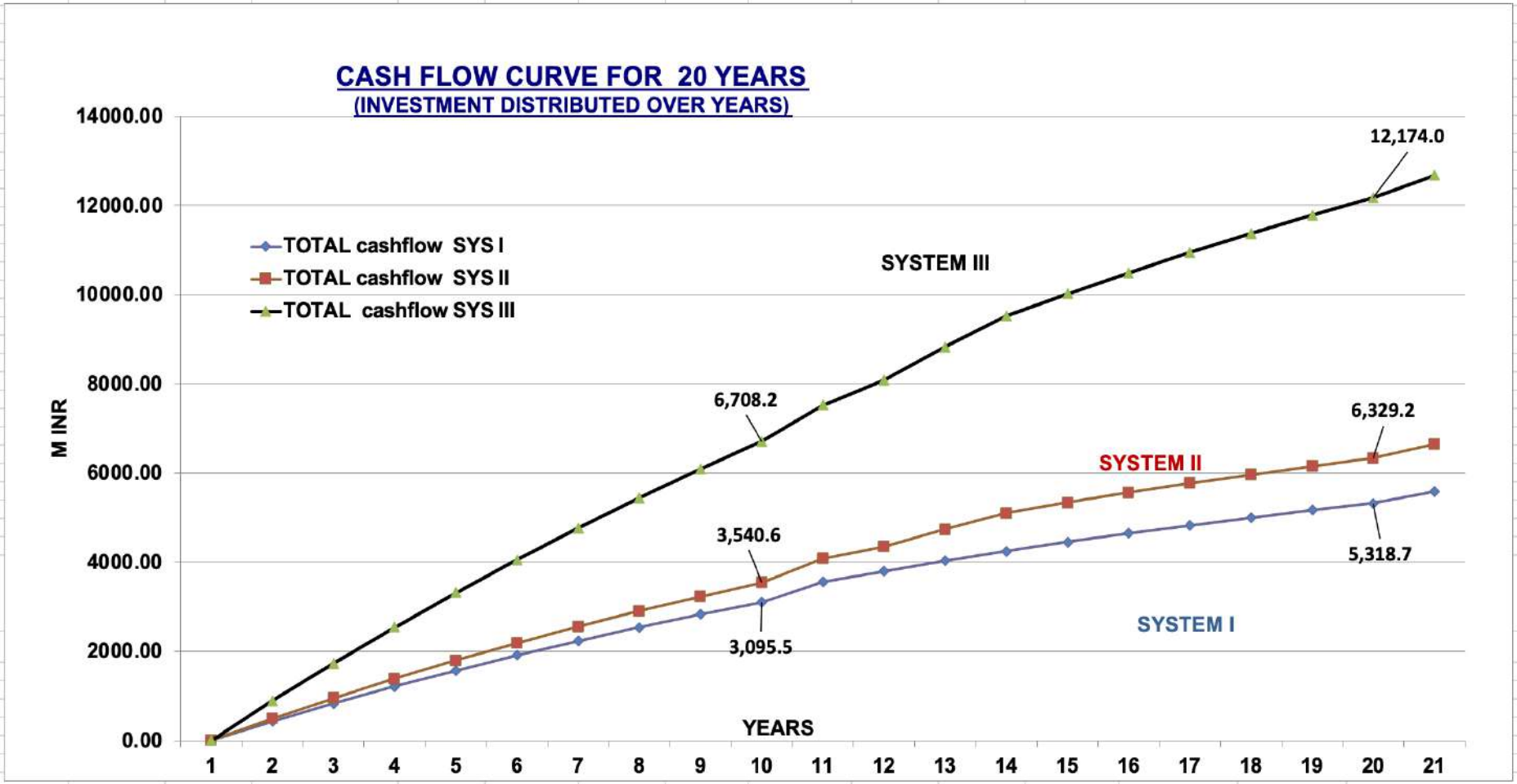
DIFFERENCE IN DUMPER COST (SYSTEM III & I/II) 16.27 Rs/te



Annual production 10.00 Mt/a **Depth of Mine** 100.00 m

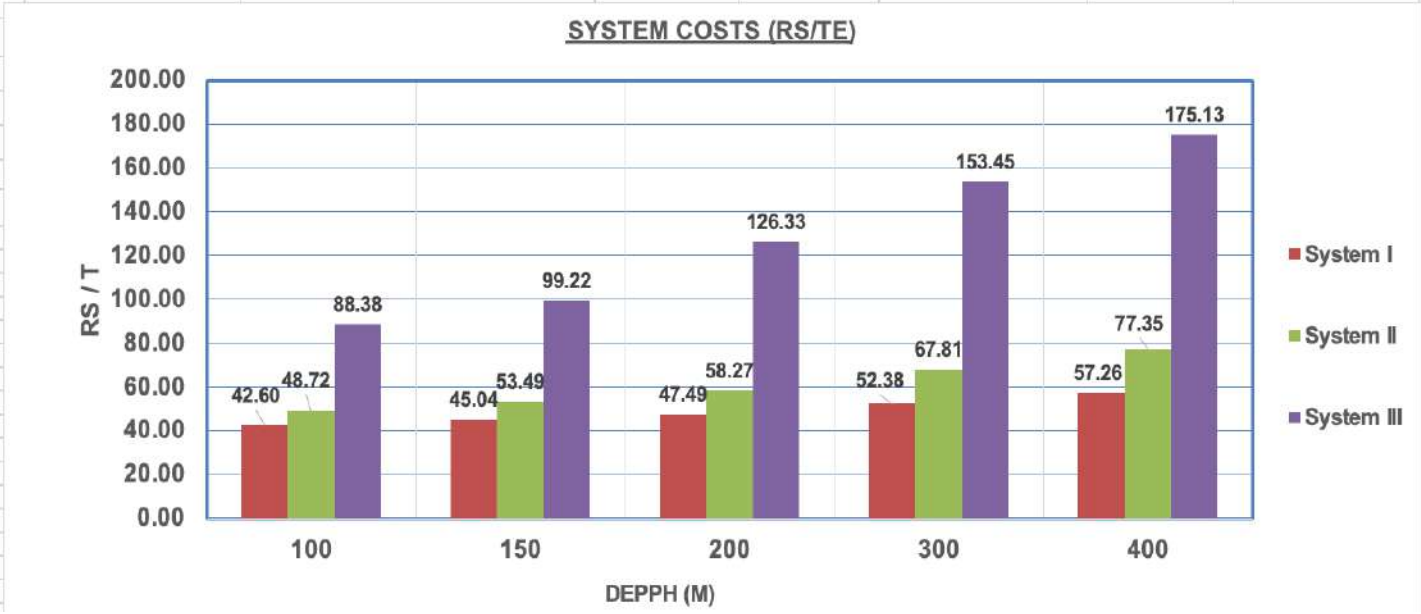
Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements - Cash flow curves for 3 systems for 100 m depth and 10 mtpa production

Annual production	10.00	Mt/a	Depth of Mine	100.00	m



Calculation program developed by S.K.Bag based on mine optimization program of Krupp Foedertechnik, Germany with indigenous cost elements – Comparison of three systems for 10 mtpa capacity and 100m, 150m, 200m, 300m and 400m depth showing EMI and yearly gain

			Rs / te				Yearly gain	Yearly capital cost (EMI) for HAC
Macro command	Annual production (mtpa)	Depth (m)	System I	System II	System III	Difference between System & III	MINR	MINR
CNTRL+SHFT+L	10.00	100	42.60	48.72	88.38	45.78	457.80	60.76
CNTRL+SHFT+M	10.00	150	45.04	53.49	99.22	54.18	541.81	76.45
CNTRL+SHFT+N	10.00	200	47.49	58.27	126.33	78.85	788.48	92.14
CNTRL+SHFT+P	10.00	300	52.38	67.81	153.45	101.07	1010.70	123.53
CNTRL+SHFT+R	10.00	400	57.26	77.35	175.13	117.87	1178.70	154.91



THE ISSUE

The Ministry of Coal has set a target to generate 1.0 billion tonnes (BT) in FY25 from current annual coal production of around 710 MT. A key objective of the nation is the development of rapid, affordable, and environmentally responsible coal transportation. In order to eliminate road transportation of coal in mines, the Ministry of Coal has taken action to improve the mechanised coal transportation and loading systems under the “First Mile Connectivity” programs.

Issue is whether dumper transport shall continue within pit to cope with target production of 1.0 BT. Production shall have to be increased mostly from potential operating mines and deeper horizons. Owning and operating cost for dumper system shall be very high. Present global warming is a challenge for the whole World.

Which coal transportation system in opencast mine shall be more productive, rapid, economic and environmentally responsible? Dumper, In-pit Conveyor (IPC) or High Angle Conveying system (an advanced in-pit conveying system with steep angle and through side-wall of mine). Obviously DSI high angle conveyor system shall be the most economic system (calculation presented). Dumper transport shall contribute to global warming, whereas DSI high angle conveyor transport shall be the green transport technology in the mine.

CMPDI in their case study for application of steep angled conveyor in deep opencast coal mine has shown savings in cost of production by Rs 78/ per ton (for 15 million ton per annum annual savings shall be Rs 117.00 crores) and additional capital expenditure by about Rs 25.00 crores for reducing 60 ton dumpers by 87 nos.

High Angle Conveyor can be easily dovetailed in operating mine, while continuing with dumper transport.

1. High Angle Conveyor can be laid in a suitable bench along the sidewall, where dumpers shall unload onto the tail end of the high angle conveyor through shiftable modular unloading arrangement, while continuing existing dumper transport to operate through the haul road. There will be no issue of its route interference with haul road. System may be similar to Kotre Basantpur, Gare Palma II, Siarmal opencast projects.
2. There will be no chance of failure of high angle conveyor due to snapping of belt, since, high angle conveyor is a booster conveyor with 40% less tension than conventional conveyor and there will be two belts running together instead of one in conventional conveyor system.
3. There will be no necessity to widen the haul road unlike for installing separate in-pit conveyor in case of IPCC.
4. No chance of accident from dumper.
5. There will be only one take out conveyor unlike nos. of in-pit conveyors with IPCC in the mine.
6. Length of high angle conveyor shall be much shorter (near to mine depth) whereas, length in-pit conveyors in IPCC shall be equal to dumper route.
7. No alignment and levelling problem.
8. High Angle Conveyor allows 120 m un-supported length and shall need support beyond this length. Very less support and civil work shall be required.
9. Much easier to install and operate.
10. Requires much less spares and less manpower than in-pit conveyor..

11. Life of High Angle Conveyor shall be around 20 years.
12. Coal shall be transported from pit bottom concealed between two belts and as such transport of coal shall be green transport system.
13. Cost shall increase marginally with increase of depth and whereas cost shall increase exponentially for dumper and in-pit conveyor system with increase of depth (see the calculation).
14. Separate provision of drainage shall not be required.
15. More space shall be available for internal dump.
16. System availability shall be higher than in-pit conveyor system due to only one high angle conveyor system.
18. Much less lighting cost than in-pit conveyors along the conveyor route.
19. Less cost for fire protection.
20. Shall be almost pollution free out of dust and exhaust fumes and sound from dumpers.
21. Coal shall reach surface much quicker than dumper and in-pit conveyor.
21.The system shall be very safe & free from operational hazards of dumpers in the mine. (**see the video in next slide**)
22. *Dos Santos International, USA shall be committed to give all the supports and training and also do erection and commissioning of the system.*
23. *Dos Santos International, USA shall be committed to manufacture the high angle conveyor in India with indigenous parts and accessories. This shall reduce cost of DSI system by around 40%, on a/c of shipment, CFI and customs duty.*

MAULES CREEK MINE TRUCK COLLISION

https://youtu.be/zkFAFZGmVkM

Learning from investigations: Maules Creek Mine truck collision. On 21 April 2018, a worker suffered serious injuries when the 100 tonne service truck he was driving collided with a 500-tonne haul truck at the mine. The worker in the service truck suffered back, shoulder and wrist injuries. The service truck suffered substantial damage. The operator, a labour-hire worker, aged 43, received serious injuries in the collision. The injured worker was transported by helicopter to hospital where he underwent medical treatment. The Hitachi haul truck is one of the largest rigid-frame trucks used in NSW mines with a payload of 296 tonnes and gross vehicle weight of 500 tonnes.

A worker suffered serious injuries when the service truck he was driving and a large haul truck collided. The injured worker was transported to hospital for treatment. The NSW Resources Regulator has commenced an investigation into the incident.

Serious injury

Incident date: 21 April 2018

Event: Serious injury at open cut coal mine

Location: Maules Creek Mine, Maules Creek NSW

Overview

A worker suffered serious injuries when the service truck he was driving and a large haul truck collided. The injured worker was transported to hospital for treatment. The NSW Resources Regulator has commenced an investigation into the incident.

Photograph 1: Damaged front end of service truck.

The incident

At about 7.58 am on 21 April 2018, a Caterpillar 773 service truck and a fully-laden Hitachi EH5000 haul truck collided at a major four-way intersection on the mine haul road.

The service truck suffered substantial damage. The operator, a labour-hire worker, aged 43, received serious injuries in the collision. The injured worker was transported by helicopter to hospital where he underwent medical treatment.

The Hitachi haul truck is one of the largest rigid-frame trucks used in NSW mines with a payload of 296 tonnes and gross vehicle weight of 500 tonnes.

The Caterpillar service truck is used to transport diesel and refuel mobile and fixed plant in-pit. The service truck has a gross vehicle weight of 103 tonnes.

Photograph 2: Four-way haul road intersection showing trucks involved in the collision.

GLOBAL REFERENCE PROJECTS
OF
DSI HIGH ANGLE CONVEYOR

TABLE 1. High Angle Conveyor - HAC® Installations - Continental Conveyor & Equipment Company

	COMPANY / LOCATION	MATERIAL	RATE (t/h)	CONVEYING ANGLE (°)	ELAVATING HEIGHT (m)	LENGTH (m)	BELT WIDTH (mm)	BELT SPEED (m/s)	DRIVES (kW)		IN OPERATION
									TOP	BOTTOM	
1.	Demo unit / Winfield, AL, USA	Various	To 2903	30 to 60	7.9 to 19.5	35.0	1524	0 to 6.1	75	112	1983
2.	Triton Coal Co. / Gillette, WY, USA	Coal	2540	60	32.9	56.7	1524	5.33	149	224	1984
3.	Majdanpek Mine / Yugoslavia	Copper ore	4000	35.5	93.5	173.7	2000	2.67	450	900	1992
4.	Coal Company / Western USA	Coal	2903	35	29	61.9	1829	4.57	149	224	1987
5.	Granite Constr. Co. / LA, CA, USA	Excavated earth	272	90	31	39.9	914	1.6	22.4	22.4	1988
6.	Waste Treatment Co. / NY, USA	Sludge	.272	90	3.66	8.6	610	0.3	0.0	2.2	1989
7.	Boise Cascade / Wallula, WA, USA	Wood chips	173	53	32.6	49.3	1219	2.03	22.4	22.4	1989
8.	Coal Prep Plant / Eastern USA	Raw coal	1089	49	21.9	40.2	1372	2.79	56	56	1990

9.	Beth Energy Mines / Van, WV, USA	Clean coal	726	90	76.2	90.2	1372	2.79	112	112	1991
10.	Boise Cascade / Steilacoom, WA, USA	Wood chips	65.3	90	15.5	31.4	914	2.03	7.5	7.5	1991
11.	Valley Camp of Utah / Helper, UT,USA	Raw coal	1089	65	30.7	44.2	1372	3.56	93.2	93.2	1990
12.	Island Creek Corp. / Oakwood, VA, USA	Coal refuse	454	To 41	174.8	454.2	914	2.34	186	186	1992
13.	Steel Cement Ltd. / Australia	Gypsum, slag	50	90	16.2	37.8	600	1.67	7.5	7.5	1991
14.	Kimberly Clark / Canada	Wood chips	229	53	22.9	40.5	1219	2.03	18.6	18.6	1991
15.	Cape May County / NJ, USA	Compost	40.3	90	9.0	17.5	762	1.27	0.0	11.2	1991

16.	Cape May County / NJ, USA	Compost	40.3	90	13.0	31.8	762	1.27	0.0	11.2	1991
17.	Shipping Company / Mexico	Grain	584	90	18.9	27.4	1524	4.06	56	56	1991
18.	Shipping Company / Mexico	Grain	1361	90	22.0	181.0	1829	4.06	112	112	1993
19.	Coal Company / Eastern USA	Clean coal	544	90	16.1	69.4	1372	2.79	37.3	75	1991
20.	Shipping Company / Mexico	Grain	907	65	30.7	44.2	1372	3.73	75	75	1993
21.	Gleason-Pequiven / Venezuela	Phosphate Rock	668	-35.5	Drop 34.0	113.0	914	2.29	0	93.2	1992
22.	Cementos Veracruz / Mexico	Hot Clinker	715	35	41.3	198.9	1219	1.73	56	112	1992
23.	Midwest Conveyor / FL, USA	Coal	1814	48	14.2	57.0	1829	3.56	75	112	1992
24.	U.S. Gypsum / NY, USA	Gypsum Rock	363	90	36.6	48.5	1067	1.52	37.3	37.3	1992
25.	The Conveyor Co. / WI, USA	Sludge	9.1	90	6.5	15.6	610	1.22	0.0	/7.5	1992
26.	Mountain Coal Co. / CO, USA	Raw Coal	1361	51	22.6	44.2	1524	3.56	75	93.2	1992

27.	Mountain Coal Co. / CO, USA	Raw Coal	272	35	15.0	37.5	1219	1.27	11.2	14.9	1992
28.	Taulman Systems / Canada	Compost	81.6	90	20.0	36.3	762	1.78	11.2	11.2	1992
29.	Montague Systems / WY, USA	Coal	1950	57	59.4	90.8	1829	3.66	186	298	1993
30.	Turns Coal Co. / IL, USA	Coal	1361	90	102.0	113.0	1524	4.57	298	298	1993
31.	Sasol / South	Coal	400	90	13.3	39.3	1200	2.2	30	30	1993
	Africa										
32.	Sasol / South Africa	Coal	400	90	13.3	40.3	1200	2.2	30	30	1993
33.	Sasol / South Africa	Coal	400	90	13.3	43.4	1200	2.2	30	30	1993
34.	Sasol / South Africa	Coal	600	90	13.3	40.3	1350	2.6	45	45	1993
35.	Sasol / South Africa	Coal	600	90	13.3	40.3	1350	2.6	45	45	1993
36.	Bechtel / NV, USA	Gold Ore	689	60	28.9	58.4	1219	1.65	37.3	56	1993
37.	Perini / MA, USA	TBM Muck	1266	90	70.1	83.8	1372	3.56	186	186	1993
38.	Palm Beach Resource / FL, USA	RDF	45.3	45	23.8	40.2	1372	1.15	0	15	1993

39.	Colver Power Plant / PA, USA	Coal	260	55	28.3	60.4	762	2.29	22.4	22.4	1994
40.	Colver Power Plant / PA, USA	Coal	260	To 60	46.9	78.9	762	2.29	30	37.3	1994
41.	Butterley Eng. / U.K.	Various	To 50	90	9.0	11.3	500	2.5	3	3	1993

TABLE 1. Latest DSI Sandwich Belt High Angle Conveyor Installations since 2010

DS #	Location	Material/ Rate (t/h)	Ang (º)	Elev. (m)	Lgth (m)	Width (mm)	Speed (m/s)	Top/Bot (kW)	Year
098	Refinery/ Muzkiz, Spain	Pet Coke/ 475	90 —	21.2	32.3	1400	3.5	45/ 45	2012
099	Refinery/ Cartagena, Spain	Sulfur/ 40	90 —	10.5	20.6	600	2.0	7.5/ 7.5	2012
100	Copper Mine/ Balmecera, Chile	Filter Cake/ 77	64	7.2	14.8	762	1.3	7.5/ 7.5	2011
101	Pulp & Paper Mill/ Maine, USA	Hog Fuel/ 54.4	90 —	7.7	16.6	1067	1.52	7.5/ 7.5	2012
102	Cu-Au Mine/ BC, CN	Pebble Ore/ 340	67	24.2	49.8	914	2.1	29.8/ 29.8	2015
103	Pastil Plant/ South England	Sulfur Pastils/ 20	50.5	19.3	55.8	600	0.4	3.7/ 3.7	2015
104	Cement Plant/ Paraiba, Brazil	Raw Feed/ 720	60	20.3	61.5	1220	3.1	56/ 56	2015
105	Export Terminal/ South LA, USA	Coal/ 3629	52	18.5	45.9	2438	4.32	224/ 224	2016

THE FUTURE LIES AHEAD

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